

REPLACE UNDERSIZED ENTRANCE STATION AT FALL RIVER ENTRANCE

PMIS #: ROMO 160755

Also includes PMISes:

ROMO 199703: Rehabilitate Bighorn Ranger Station/Fall River Entrance Station Wastewater System

ROMO 249028: Rehabilitate Bighorn Ranger Station/Fall River Entrance Water System

ROMO 318223: Fall River Road Transportation Improvements

FINAL CONSTRUCTION DOCUMENTS

Construction Specifications & Appendices

ROCKY MOUNTAIN NATIONAL PARK

10 March 2021

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Golden, CO 80401
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SECTION 00 01 07

SEALS PAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Professional seals by Design Professionals and others responsible for preparing Construction Documents:

1. Architect:



2. Landscape Architect



3. Civil Engineer:



03/10/22

4. Structural Engineer:



03/10/22

5. Mechanical Engineer:



5. Electrical Engineer:



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APPENDICES

APPENDIX A: Geotechnical Investigation Report, Rocky Mountain National Park Fall River Entrance, by Yeh and Associates, dated September 15, 2021

APPENDIX B: Mortar Analysis, by Barlow Cultural Resource Consulting, LLC, dated September 21, 2021

APPENDIX C: Hazardous Materials Assessment Report For Rocky Mountain National Park, Fall River Entrance Station, Estes Park, Colorado, by Landmark Environmental, Inc. dated February 23, 2022.

APPENDIX D: Areas Requiring Archeological Monitoring, provided by NPS ROMO.

APPENDIX E: Revegetation Project Summary, provided by NPS ROMO, received December 16, 2021.

APPENDIX F: Class III Cultural Resource Inventory for the Bighorn Ranger Station/Fall River Entrance Wastewater and Water Systems at Rocky Mountain National Park, Larimer County, Colorado, Metcalf Archaeological Consultants, Inc., dated March 2021.

APPENDIX G: Statement of Structural Tests and Special Inspections, JVA, Inc., dated March 10, 2022.

END OF SECTION 00 01 10

SECTION 01 11 00 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 11 00 “Summary of Work” includes the following:
1. Work covered by the Contract Documents.
 2. Government Furnished Materials.
 3. Contractor use of site.
 4. Public use of site.
 5. Work Restrictions.
 6. Protection of Existing Vegetation, Structures, Equipment, Utilities and Improvements
 7. Special Construction Requirements.
 8. Additional Compliance Requirements.
 9. References.
 10. Soils Investigation Report.
 11. Additional Reports.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Location: Rocky Mountain National Park, Fall River Entrance. Northwest of Estes Park, Colorado; Five (5) miles from intersection of US 34 and US 36 (N St. Vrain Ave.) along US 34 (in town from that intersection called E Wonderview Ave.). Site is currently an existing entrance station.
- B. The Work includes but is not limited to:
1. Base Contract: The Work includes but is not limited to removal of existing three (3) entrance kiosks, associated office building, and monument sign; removal and replacement of pavement adjacent to entrance buildings; construction of new office building and three (3) entrance kiosks (all wood framed buildings with concrete foundations and slab, cementitious siding, boardformed concrete veneer base, aluminum clad wood windows, standing seam metal roof); repair of a historic masonry curb, reconstruction of two historic masonry culvert headwalls, replacement existing waterlines; replacement of water treatment system and well pump; replaced electrical infrastructure for replaced system and pump, rehabilitation of sanitary lines with Cured In Place Pipe (CIPP) and replacement of the Onsite Wastewater Treatment System (OWTS). Electrical work also includes coordination with Estes Park Power and Communications for an extension on the primary distribution and a new pad mounted transformer along with all related sitework. Communications work includes coordination with Lumen to relocate an existing pedestal and associated underground lines. A new wooden pole and conduit will also be provided for future NPS data infrastructure. Building work (office and kiosks) includes typical interior finishes: gyp board walls, paint, wall tile, sheet flooring, cabinetry, hollow metal exterior doors, wood interior doors, and a single user restroom. Supporting infrastructure shall include full security system, including multiple cameras and onsite server, power and

data in all buildings, heating ventilation and cooling for all buildings, including positive pressurization of all kiosks. Site improvements include: new asphalt and reinforced concrete roadway paving, curbing, staff parking area, epoxy pavement markings, accessible sidewalks and curb cuts, concrete patio area, rumble strips, traffic alert signage, buried traffic counter loop, replacement of an existing gate and construction of a new vehicle turnaround area. A spare communications conduit will also be provided for future fiber optic connectivity between the Bighorn Ranger Station and Fall River Entrance Office Building.

- a. This scope of work has two contract line items separated out from the base scope of work: the Wastewater System rehabilitation and the Water System rehabilitation with associated historic culvert replacement and pump house repair. See Section 01 27 00 "Definition of Contract Line Items" for specific information on division of scope.
2. Bid Option 1 - Road Widening: includes but is not limited to extending the additional lane from the base scope to the park boundary. This involves additional road construction (asphalt, striping) and associated grading, revegetation and irrigation. See also annotations on civil site plans.
3. Bid Option 2 – Pavement Striping: includes but is not limited to alternate pavement striping and markings materials assuming a 2-part epoxy paint and thermoplastic pavement markings (i.e. ABAAS symbols, etc.).
4. Bid Option 3 – Monument Sign with Accessible Parking: includes but is not limited to new monument sign (wood posts and panel, steel structure, concrete foundations, stone veneer base), asphalt pavement, retaining wall adjacent to parking lot, concrete paving, and a concrete valley cross pan adjacent to the parking area for the monument sign pull-off. Also included in this option is a stormwater solution to route drainage from the roadside ditch beneath the pull-off and back into the roadside ditch to the east.
5. Bid Option 4 – Variable Message Sign: includes but is not limited to wood posts, steel structure, concrete foundations, stone veneer base, trenching/conduit/power/communications to the sign, a supplemental conduit (laid in same trenching) for future electrical primary replacement, and electronically changeable message sign.
6. Bid Option 5 – Stone Veneer: includes but is not limited to substitution of base bid boardform concrete veneer on the office and kiosk buildings for granite stone veneer.
7. Bid Option 6 – Weathering Steel Roofing and Elements: includes but is not limited to substitution of the base bid prefinished standing seam metal roofing for standing seam bare "weathering" steel roofing. Also substitutes steel bollards, steel sidewalk grate, truncated dome pavers, exposed steel columns and steel screens (at back of office building) with same element composed of weathering steel.
8. Bid Option 7 – Reset Granite historic CCC Curb: includes but is not limited to salvaging and resetting the historic CCC curb on a stabilized base. This work is conditional if additional work beyond base bid exposure and repair of historic CCC curb is directed by Contracting Officer.
9. Bid Option 8 – Lightning Protection: includes but is not limited to lightning protection for the new buildings.

10. Bid Option 9 – West Horseshoe Paving: includes but is not limited to project close repaving of the West Horseshoe parking lot / pulloff area that will be used as a staging area.
 11. Bid Option 10 – Culvert under Fall River Road: includes but is not limited to replacement of one (1) existing culvert, two (2) new concrete culvert headwalls constructed of integrally colored concrete with a boardformed finish, and associated grading and revegetation.
 12. Bid Option 11 – Fall River Road Culvert Headwall Stone Veneer Finish: includes but is not limited to a different culvert headwall design that includes stone veneer, stone wall cap, and the additional foundation width to support the stone veneer. Basis for design is described in Section 01 27 00 “Definition of Contract Line Items.”
- C. Project will be constructed under a single prime contract.
- D. The work is intended to be conducted over one construction season but may take place over two years.
1. The intended one year construction period assumes parallel areas of work.
 2. References to “phasing” in the specification and drawings shall refer to changes in vehicular routing through the construction area and not to project phases.
 - a. Phasing of construction is suggested but not dictated by the drawings. The Contractor is encouraged to propose other methods of managing the work to fit into the schedule.
 3. The culvert replacement is preferred to be scheduled during the dry season (fall) but may be conducted in the wet season (spring) or sometime in between.
- E. Concurrent Work:
1. The Town of Estes Park has announced a project called the “Downtown Estes Loop” project that will improve the roads through the town immediately to the south of the Fall River Entrance area. This roadwork may affect access for workers and deliveries as well as potentially affect resource availability. The anticipated construction timeline at the time of publication of this document is Summer 2022 through Fall 2023.
 - a. For contact information and the most current public information, contractor may reference the following Federal Highway Administration website: <https://highways.dot.gov/federal-lands/projects/co/estes>
 2. Utility improvements that may be occurring at the same time:
 - a. Fiber Optic expansion into the area, including the buildings/homes near Alpenglow campground. Laying the new cable may pass through the construction site.
 - b. Electrical Utility Improvements undertaken for this project shall be performed concurrently.
 - c. Contractor shall coordinate with contractors and/or representatives for the parallel projects such that all concurrent work shall proceed with minimal conflicts.

1.3 GOVERNMENT-FURNISHED MATERIALS

A. Delivery and Storage

1. Contractor is responsible for receiving, unloading, and handling Government-furnished items at Project site.

2. Contractor is responsible for protecting Government-furnished items from damage during storage and handling, including damage from exposure to the elements.
3. If Government-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.
4. Contractor shall install and otherwise incorporate Government-furnished items into the Work.

B. Government-Furnished Products:

1. Ponderosa pine trees for revegetation shall be supplied by the park. Contractor shall be responsible for salvaging, storing (only if necessary), and planting the trees. Contractor shall coordinate revegetation work with Contracting Officer.
2. Webcam for traffic camera. Contractor shall install as identified in the drawings.
3. Toilet Accessories: toilet paper dispenser, paper towel dispenser, soap dispenser. Contractor shall install as identified in the drawings.

C. Items Salvaged Onsite:

1. Old green safe that is within the wall cupboard in the current office. To be salvaged and placed in a corner of the storage room in the new building.
2. Arrowhead from entrance sign.
3. Leftover granite veneer from the construction of retaining walls and Bid Option 5.
4. Select road signs (see site demolition plan).
5. Ponderosa pines to be salvaged and relocated.
6. Boulders alongside road (see site demolition plan) to be salvaged and relocated.

1.4 CONTRACTOR USE OF SITE

- A. General: Contractor shall have full use of the area within construction limits for construction operations during the construction period, including use of the project site and designated staging area. Contractor's use of the site is limited only by the Government's right to perform work on-site or adjacent to the site and storage of materials/equipment on acceptable surfaces.

1. Construction limits are called out in the construction drawing set on civil sheets and Maintenance of Traffic (MOT) sheets.
2. Government shall need weekly access to buildings and well in Bighorn Ranger Station area.
3. Limit site disturbance to area identified as construction limits in the civil drawings.
4. To minimize impact to the park's natural and cultural environment, use lowest impact methodologies for trench excavation.

B. Staging Areas and Storage of Materials:

1. Staging Areas include:
 - a. West Horseshoe Park Parking Lot (2.5 miles west on Fall River Road)
 - b. Disturbed areas to sides of road within Limits of Disturbance.
 - c. Hardened parking lot and access road to Bighorn Ranger Station buildings within Construction Limits.

2. Confine storage of materials to within construction limits and designated staging area, unless directed otherwise by Contracting Officer.
 3. Locate staging and stockpiling areas in hardened areas. Return all staging and stockpiling areas to pre-construction conditions following construction.
 4. When possible, place soils on asphalt, paved areas, planks or tarps to reduce ground and vegetation disturbance.
 5. Equipment will be kept on hardened surfaces, except where needed to perform grading and utility work.
 6. Washout Area(s): Shall be offsite or in repairable areas as approved by the Contracting Officer prior to start of work. Washout sites shall be returned to their original, pre-construction condition, at the close of work. If on Government Property, repaired/cleaned washout site(s) shall be reviewed and approved by Contracting Officer.
- C. Highway (Fall River Road/US 34): Keep highway open, clear, and available to public, Government, Government's employees, and emergency vehicles at all times. One lane in each direction is required to be provided. Areas on the shoulder and within Construction Limits may be used for parking or storage of materials.
1. See also Section 01 50 00 "Temporary Facilities and Controls" for full description of provisions required at highway.
- D. Driveways and Entrances: Keep access road serving Aspenglen Campground clear and available at all times for Government, Government's employees, and emergency vehicles, and public and residents for the campground road. 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.
- E. Construction Camp: Establishment of a camp within the park will not be permitted.
- F. Construction Trailer: Establishment of a construction trailer will be permitted in West Horseshoe Park parking lot or near Fall River Entrance building site, provided it is within the Construction Limits. Provide utilities as specified in Division 1 Section 01 50 00 "Temporary Facilities and Controls." Keep trailer area neat and clean and return site to previous condition at completion of work.
1. No utility or communication connections are available at West Horseshoe Park.
- G. Construction Equipment:
1. Construction Equipment shall not be stored along open roadways overnight, without prior approval of the Contracting Officer.
 2. Construction equipment shall not be permitted to idle for longer than five (5) minutes.
- H. Hauling Restrictions: Comply with all NPS and DOT load restrictions in the hauling of materials. Load restrictions on park roads are identical to the state load restrictions with such additional regulations as may be imposed by the Chief of Visitor and Resource Protection. Information regarding rules and regulations for vehicular traffic on park roads may be obtained from the Contracting Officer. A special permit will not relieve Contractor of liability for damage which may result from moving of equipment.

1.5 PUBLIC USE OF SITE

- A. The highway will be open to the public during construction.
- B. Contractor shall at all times conduct their operations to ensure the least inconvenience to the public. Temporary closures of all lanes of traffic may be necessary for brief, intermittent periods. Night work may be considered to minimize disruption of access and placement of steel plates over work areas to facilitate access during non-work hours will be permitted contingent on Contracting Officer approval (see also 1.6 On-Site Work Hours, requirement for Contracting Officer approval for work performed beyond normal working hours).
 - 1. Temporary closures of longer than 10 minutes shall be coordinated in advance with park staff.
 - 2. Temporary closures of 10-30 minutes shall be discussed during Construction Progress Meetings.
 - 3. Temporary closures of greater than 30 minutes shall be applied for 72 hours in advance of closure date/time.
 - 4. Contractor shall follow terms for closures detailed in Section 01 50 00 "Temporary Facilities and Controls."
 - 5. Temporary traffic control outside of Federal property is subject to approval by the Town of Estes Park and CDOT.
- C. Emergency Vehicle Access is required at all times. Contractor shall coordinate with dispatch to ensure access is provided.

1.6 WORK RESTRICTIONS

- A. On-Site Work Hours: Work shall be generally performed during normal business working hours of 6 a.m. to 6 p.m., Monday through Friday, except as otherwise arranged with Contracting Officer.
 - 1. No work shall be performed beyond normal working hours, on weekends or federal holidays without prior approval of the Contracting Officer.
- B. Existing Utilities: Notify Contracting Officer and utility companies of proposed locations and times for excavation.
 - 1. The utilities shown in the drawings are indicated in accordance with available records. All utilities may not be shown and those which are shown may not be shown accurately. The contractor shall be responsible for field locating all utilities including public utilities and NPS owned utilities to determine exact locations, elevations and sizes.
 - 2. Contractor shall be responsible for calling the Colorado 811, (800) 922-1987 and park a minimum one week in advance of digging. Contractor may be required to use additional methods for utility locations, such as electromagnetic utility locating, acoustic pipe locating, ground penetrating radar or potholing.
 - a. Public Utilities include:
 - 1) Primary Power: Town of Estes Park, Power and Communication Department
 - 2) Telephone: Lumen

- 3) Cable/Internet: Lumen
 - 4) Sewer outside the Park: Upper Thompson Sanitation District
 - 5) Water outside the Park: Town of Estes Park
- b. NPS Utilities include:
- 1) Water
 - 2) Sewer
3. Work Near or Affecting Existing Utilities
- a. Existing Utilities: Notify Contracting Officer and utility companies and park of proposed locations and times for excavation not less than one week in advance.
 - b. Contractor shall be responsible for locating and preventing damage to known utilities. If damage occurs, repair utility at no additional expense to the Government.
 - c. If damage occurs to an unknown utility, repair utility. An equitable adjustment will be made in accordance with the Changes clause of the contract.
4. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under the following conditions:
- a. Notify Contracting Officer and park not less than one week in advance of proposed utility interruptions.
 - b. Do not proceed with utility interruptions without Contracting Officer's written permission.
- C. Multiple areas of work: Due to the short construction period, this project scope assumes parallel areas of work, such as utility improvements at the same time as demolition and construction at the entrance station. The Contractor may propose strategies, alterations, or economies to achieve the documented design intent within the required completion date, which must be reviewed and approved by the Contracting Officer prior to any action being taken to enact any of these.
- D. Nonsmoking Building: Smoking is not permitted within buildings or within 25 feet of entrances, operable windows, or outdoor air intakes.
- E. Fire Restrictions: The contractor shall be responsible for keeping informed and informing all on-site staff regarding current fire restrictions at the park. This may include an outdoor smoking prohibition if fire conditions warrant.
- F. Hot Work Permits: No hot work is anticipated on this project, but if the contractor finds this is necessary, the following is required.
1. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of the National Park Service Authority Having Jurisdiction.
 2. Hot work permits, approved through the Contracting Officer by the park's structural fire coordinator, are required for any hot work. Submittal of permit request is required no less than one week in advance of the work. Do not proceed until notified by the Contracting Officer that the permit has been approved.

1.7 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS

A. As required by FAR Clause 52.236-9:

1. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall treat as directed by the Contracting Officer.
2. The Contractor shall protect from damage all existing improvements and utilities (1) at or near the work site, and (2) on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

B. Provide temporary barriers to protect existing trees and plants and root zones.

C. Provide temporary barriers to protect existing cultural features, as identified by the Contracting Officer.

D. Do not remove, injure, or destroy trees or other plants without prior approval. Consult with Contracting Officer and remove agreed-on roots and branches that interfere with construction.

E. Do not fasten ropes, cables, temporary fence, or guy wires to existing trees.

F. Carefully supervise excavating, grading, filling, and other construction operations near trees to prevent damage.

G. No storage, parking, or excavation shall be allowed within the drip line of protected trees without approval from the Contracting Officer.

1.8 SPECIAL CONSTRUCTION REQUIREMENTS

A. Roads

1. Trail Ridge Road (US 34) is closed during the winter. Locations of closures will vary based on weather and road conditions. It is generally closed at the first significant snowfall (usually mid to late October) and reopened through plowing by late May. Check <https://www.nps.gov/romo> for up to date information.
 - a. Note that this is not in the project area as our project and the West Horseshoe Park staging area are on Fall River Road.
2. Old Fall River Road is closed during the winter. It is generally closed at the first snowfall (usually early to mid October) and reopened through plowing by early July. Check <https://www.nps.gov/romo> for up to date information.
 - a. Note that this section of road is also not in the project area.

3. The road restrictions in line with general height, weight, and length specs for State of Colorado highways.
 - a. The weight restrictions for the area are: 80,000 lbs. for the roadways.
 - b. No known bridges in the area that would decrease this weight rating.
 - c. The length restriction is 70' total for tractor trailers.
4. If construction vehicles will be traveling to the park from the west side of the park via Trail Ridge Road, pilot cars are required for tractor trailers from the switchbacks of Trail Ridge Road on the west side to Hidden Valley on the east side.
5. Contractor shall review and confirm the above with CDOT prior to construction traffic start, as conditions may have changed.

B. Weed Mitigation

1. All borrow, road base, aggregate, crusher fines, bedding, topsoil, hay bales and other fill materials brought into Rocky Mountain National Park and used in this project shall be certified weed free. Without certification, materials shall come from commercial sources that have been inspected by the NPS and approved prior to materials entering the Park.
2. Equipment Cleaning:
 - a. Clean vehicles and construction equipment prior to entry into the Park to minimize the potential for introduction and/or proliferation of invasive non-native weeds through project actions. The contractor is required to wash equipment, with emphasis on undercarriages, with a high pressure spray prior to transporting such equipment to Rocky Mountain National Park.
 - b. All vehicles and construction equipment entering Rocky Mountain National Park shall be inspected and approved by the Contracting Officer prior to entering the park.
 - c. Equipment not deemed clean by the Contracting Officer will not be allowed to enter the park. The contractor remains liable for additional transportation fees incurred when equipment fails inspection.
 - d. Cleaning will not be permitted within the park. Contractor shall be responsible for identifying and using a cleaning location outside the park. Note that this may be some distance from the park and project site.

C. Avoid Soil Compaction

1. Avoid compaction from heavy equipment to surrounding area by keeping equipment inside the limits of work.
2. Compacted soils must be ripped or decompacted post construction to enable vegetation.
3. All disturbances must be returned to grade and any tracks from equipment must be raked out.

D. Bird Protection Acts

1. In order to protect birds under the Migratory Bird Treaty Act (MBTA, 16 U.S.C. 703–712), all construction work performed between February 1 and August 31 requires a site survey, to be performed by a trained individual. The survey must be completed within two weeks prior to the start of construction. Additional surveys will be required after periods of no work exceeding two weeks. The Contractor will be required to avoid cutting down trees with active nests, however, other work would be permitted to continue. Some species may also require a buffer around active nests where work cannot occur.

- a. Contractor shall request a site survey a minimum of one month prior to mobilization.
2. In order to protect eagles under the Bald and Golden Eagle Protection Act (BGEPA, 16 U.S.C. 668-668c), all construction work requires a site survey, to be performed by a trained individual. The survey must be completed within two weeks prior to the start of construction and encompass the project location as well as a half mile area surrounding the project. . If an active bald eagle or golden eagle nest is found, work that causes disturbance to the eagles will not be permitted. If an active or inactive nest is found, the Contractor will be required to avoid cutting down trees with nests.
 - a. Contractor shall request a site survey from Contracting Officer a minimum of one month prior to mobilization.
3. In order to protect Mexican Spotted Owls (MSO) under the Endangered Species Act (ESA;16 U. S. C. 1531-1544), if a MSO is discovered near the project site, work will be stopped while additional consultation with the US Fish and Wildlife Service is completed. The construction site is within MSO foraging habitat.
 - a. Contractor shall request a site survey from Contracting Officer a minimum of one month prior to mobilization.

E. Reducing Wildlife Interactions

1. Do not feed or disturb wildlife within the Park boundaries. Do not approach or remain within 25 yards of any wildlife.
2. All construction personnel working in the field must follow park food storage regulations, 36 CFR 2.10. All food, garbage, toiletry, or other bear attractants must not be left unattended for any length of time.
 - a. These items shall be stored inside vehicle trunks.
 - b. In vehicles with no trunk, place these items as low in the vehicle compartment as possible and covered from sight, with all windows and doors closed and locked.
3. On-site construction personnel are required to report all bear, mountain lion, and/or any unusual sightings in the work area to the Contracting Officer.

F. Archeological Monitoring

1. The Government is providing archeological monitoring, and Contractor is required to comply with information and procedures as specified in Section 01 35 13 “Archeological and Historical Resource Protection.”

G. Work Within Rocky Mountain National Park and Coordination with Park Employees

1. Contractors will coordinate with park staff to reduce disruption to normal park activities.
2. Construction workers and job superintendent will be required to attend park resource orientation session lasting no more than two hours to learn about the special sensitivity of park values, regulations, and appropriate litter and trash control measures. The Contracting Officer will coordinate orientation session with the NPS Cultural Resource Specialist and NPS Natural Resource Specialist to develop resource awareness. Work schedule, equipment to be used on project and resource protection plan will be discussed. This training session shall occur prior to the start of work and will be repeated for changes of key personnel.

- a. Training session shall also include orientation regarding emergency procedures for local safety risks, including but not limited to lightning, flood, fire, wildlife.
- 3. The National Park Service will ensure that all contractors and subcontractors are informed of the penalties for illegally collecting artifacts or intentionally damaging archeological and/or natural sites and/or historic properties. Contractors and subcontractors will also be instructed on procedures to follow, in case previously unknown archeological and/or natural resources are uncovered during construction.

H. Blasting is not permitted in this project.

1.9 ADDITIONAL COMPLIANCE REQUIREMENTS

- A. The work of this project has been reviewed and approved by the State Historic Preservation Office for compliance with the requirements of Section 106 of the National Historic Preservation Act. To minimize impact to the cultural resources, work shall be performed as specified in Section 01 35 13 “Archeological and Historical Resource Protection.”

1.10 REFERENCES

- A. Industry Standards.
 - 1. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
 - 2. Publication Dates: Comply with standards in effect as of the date of the Contract Documents unless otherwise indicated.

1.11 GEOTECHNICAL INVESTIGATION REPORT (Appendix A)

- A. A soils investigation report entitled Geotechnical Investigation Report Rocky Mountain National Park Fall River Entrance has been prepared by Yeh and Associates, Inc and dated September 15, 2021.
- B. A copy of the report is available to all plan holders with this package.
- C. If conflicts occur between the report and drawings or specifications, the drawings and specifications govern.

1.12 MORTAR ANALYSIS (Appendix B)

- A. A mortar analysis report entitled Mortar Analysis has been prepared by Phillip Barlow, Historic Preservation Specialist and dated September 21, 2021.
- B. A copy of the report is available to all plan holders with this package.

1.13 ADDITIONAL REPORTS

- A. A hazmat report is anticipated to be produced prior to bidding, prepared in early 2022 by Landmark Environmental.
 - 1. A copy of the report shall be available to all plan holders with this package.
- B. If conflicts occur between the report and drawings or specifications, the drawings and specifications govern.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 11 00 - SUMMARY OF WORK

SECTION 01 26 01 – CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 26 01 “Contract Modification Procedures” consists of administrative and procedural requirements for contract modifications.

1.2 DEFINITIONS AND ALLOWANCES

- A. Home Office Overhead: Costs incurred in support of all of a contractor’s projects and not attributable to a specific job. The cost for home office overhead is only allowed as a percentage of all direct work excluding profit. The following items represent allowable home office overhead costs identified in Part 31 of the Federal Acquisition Regulation (FAR):

1. Rent
2. Utilities
3. Furnishings
4. Office equipment
5. Executive and management staff not exclusively assigned to the project
6. Support, accounting, and administrative staff
7. Preparation of cost proposals, estimating, and schedule analyses connected with Modifications
8. Estimating and preconstruction services
9. Mortgage costs
10. Real estate and corporate taxes
11. Automobile maintenance and travel costs for home office personnel
12. Home office insurances i.e. structure, automotive, umbrella, flood, etc.
13. Depreciation of equipment and other assets
14. Home office supplies (paper, staples, etc.)
15. Legal services
16. Accounting and data processing
17. Professional fees/registration

- B. General Conditions (Field Office Overhead): Management and administrative costs incurred on site for the designated project. Costs associated with preparation of modifications will not be allowed. Costs for these items are to be included only in the general conditions of the modification estimate. Only in the case of a contract time extension are additional general conditions included in modifications. The following items, if applicable, are considered allowable costs for calculating General Conditions:

1. Project Manager (PM), Assistant Project Manager
2. Superintendent, Assistant Superintendent
3. Quality Control, Safety Officer, Environmental Manager, etc.
4. Engineers
5. Travel, lodging, and per diem (as established by Federal Travel Regulations)

6. Scheduling
7. Field Office Trailers and associated temporary utilities
8. Field office supplies
 - a. Mailing and couriers
 - b. Reproduction costs
 - c. Storage
 - d. Phones
 - e. Computers
 - f. Copiers
9. Personal vehicles i.e. Superintendent Pickup trucks

C. General Requirements: Costs directly associated with the project and are necessary to perform the actual work of the modification. These costs shall be shown as direct costs in the estimate. The following items, if applicable, are considered allowable costs for calculating General Requirements:

1. Hoisting
2. Material handling
3. Temporary fencing
4. Port-a-lets
5. Trash removal, dumpsters
6. Barricades
7. Small tools
8. Safety supplies
9. Scaffolding
10. Daily cleaning
11. Traffic control
12. Temporary signage
13. Temporary heating and power

D. Personnel Costs: Costs included in the modification must only be for General Conditions staff and workers actually present and working on project site. Modification costs for salaried workers are only allowed within the structure of a 40-hour week and no overtime or holiday pay will be allowed.

1. Worker Hourly Rates are costs directly associated with the individual worker and consist of the following:
 - a. Base Rate: The hourly rate paid directly to the worker
 - b. Labor Burden: Employer payments of all applicable burdens; includes insurance and taxes the business must pay on behalf of the worker to government entities and educational forums, such as:
 - 1) Social Security
 - 2) Medicare
 - 3) Workers Compensation – Policy and company calculation to be made available.
 - 4) Federal Unemployment Tax Act (FUTA) - Cap Rate and percentage to be proportionally allocated over one year.

- 5) State Unemployment Tax Act (SUTA) - Cap Rate and percentage to be proportionally allocated over one year.
 - 6) Union agreement costs - Other costs required under an enforceable collective bargaining agreement.
- c. Fringe Benefits: Various non-wage compensations provided to employees such as:
- 1) Health Care Insurance Premiums
 - 2) Cell Phone
 - 3) Clothing
 - 4) 401K and Pensions
 - 5) Vehicle allowances
 - 6) Gas allowance
 - 7) Life insurance premiums
 - 8) Disability insurance
 - 9) Other Fringe Benefits required under an enforceable collective bargaining agreement
- E. Bonuses or Deferred Compensation: No Bonus or Deferred Compensation will be allowed within any components of pricing including Home Office Overhead, General Conditions, General Requirements, Hourly Worker Rates, or the direct costs of work.
- F. General Liability Insurance: An insurance policy that protects Contractor from claims resulting from bodily injury or property damage to a third party. Include as a separate line item within all modification proposals and provide a current insurance quote upon request.
- G. Performance and Payment Bonds: A performance bond is a surety bond issued by an insurance company or bank to guarantee satisfactory completion of a project. The Payment Bond guarantees the Contractor will pay the labor and material costs incurred. Banks and Insurance companies charge a premium for individual project based on a sliding scale related to the size of the project. Include as a separate line item in modification proposals and provide current company bonding rates upon request.
- H. Builder's Risk Insurance: Covers the contractor's loss due to fire, high winds, or other natural forces. Not reimbursed by the National Park Service (NPS) and shall not be included in modification proposals.

1.3 MODIFICATION PROPOSAL PRICING REQUIREMENTS

A. General:

- 1. Proposal be received in the format and within the time frame specified in the Request for Proposal (RFP) letter. Costs or delays resulting from failure of contractor to submit within the time frame specified will not be compensable.
- 2. Proposal shall be detailed with itemized lists of equipment, materials, labor, production rates, overhead, profit, and bond markup for each item. Labor costs must be itemized by craft and hourly rate, including Fringe Benefits and Labor Burden. If the costs of Fringe Benefits and Labor Burden are not itemized, it is assumed they are included in the hourly rate shown, or contractor is not requesting reimbursement. Contractor may

utilize the government provided [Contractor Estimate Form](#), or their own form, provided that it contains the same information and level of detail as the Government's form.

3. Requests for extensions of contract time as a result of change must be justified with a Time Impact Analysis (TIA). Refer to Section 01 32 16 "Construction Schedule", for time impact analysis requirements. TIA and associated costs shall be received with the proposal by the date shown within the Request for Proposal letter. Contractor's failure to submit within the specified time frame will be construed as the Contractor waiving right for additional time and no time extension will be allowed.
4. All supporting documentation used to justify the proposed modification will be made available to the Contracting Officer (CO) upon request.
5. Contractor shall review and approve all subcontractor/supplier pricing in detail for proper format, scope, production rates, and pricing prior to submission to NPS. All delay costs associated with not reviewing and approving subcontractor/supplier pricing will be borne by the Contractor.
6. All pricing and production rates within the estimate must be based on fair and reasonable pricing and cannot include built-in contingency.

B. Labor:

1. Contractor shall estimate cost of labor by itemizing each craft involved, indicating worker hourly rate (base rate + labor burden + fringe benefits) for each and itemizing hours required for each craft directly engaged in modification work. Any work proposed requiring overtime work or premium pay shall be itemized separately. Rates shall be in accordance with the Davis-Bacon Act as incorporated herein. Labor Burden may include payroll taxes, Social Security, unemployment insurances, workers compensation insurance, Federal Insurance Contributions Act (FICA), FUTA, and other direct costs resulting from Federal, State or local laws.
2. Itemize labor costs for equipment operators separate from equipment costs.
3. Labor cost for foremen shall only be costs for related work required for the modification.

C. Materials:

1. Estimated cost for materials shall include quotes from multiple sources. Material prices shall include applicable fees and credits, including but not limited to, sales tax, freight and delivery charges, and tax rebates.
2. No markup shall be applied to any material provided by NPS.

D. Equipment:

1. Equipment used for the project must be appropriately sized for work being performed.
2. Do not include costs for "miscellaneous tools and equipment", in your proposal for a replacement value of \$500 or less. Costs shown in excess of \$500 shall be broken out separately.
3. Regardless of ownership, rates to be used in determining equipment rental costs shall be the lowest cost from one of the following sources:
 - a. United States (U.S.) Army Corps of Engineers, Ownership and Operating Expense Schedule (use latest edition and applicable region)
 - b. Construction Blue Book

- c. Local equipment rental rates, documented by actual invoice charges, or itemized vendor quotes.
- 4. Estimated equipment rates shall include operating costs of all fuel, oil, lubrication, supplies, small tools, necessary attachments, ground engaging components, tires and tracks, routine repairs and maintenance (cost of major repair and overhaul is not allowed per Federal Acquisition Regulation (FAR) 31.105(d)(2)), depreciation, storage, insurance, and all incidentals. Mobilization, if applicable, may be included for equipment solely used on the modification work but must be listed separately.
- 5. Estimate full rate for equipment only for duration that equipment will be utilized to accomplish work of the modification.
- 6. Standby unit rates used in accordance with paragraph 1.3, D, 2, above. If the U.S. Army Corp of Engineers is utilized then their standby rates prevail. If Bluebook or local equipment pricing is accepted, then 1/2 of equipment costs minus any operating costs, major repair and overhaul will be accepted.
- 7. If equipment is in standby mode due solely to a documented NPS delay, established standby rate shall apply from the first day of the delay.
- 8. Equipment not used and on job site for up to five consecutive days may be classified at standby rates, provided the equipment is or has been used solely to perform work on the modification and will be necessary to complete additional modification work. Equipment still on the jobsite but not in use after five consecutive days will not be considered in the modification pricing.
- 9. Requests for compensation for equipment stand by time must be justified, documented and itemized separately.
- 10. The estimated timeframe (daily, weekly, monthly) for use of the equipment must reflect the lowest cost to the Government.

E. Establishment and Application of Overhead and Profit Percentages:

- 1. Home Office Overhead and Profit (OH&P) shall be applied to direct costs only. Profit shall not be applied to overhead amounts; and overhead shall not be applied to profit. Home office overhead shall contain only allowable, allocable, and reasonable costs per the contract documents and FAR Part 31. Profit percentages are based on risk factors found in FAR Part 31 which have been applied to the specific type of work included in this project. Negotiated rates shall not exceed the following percentages for OH&P for contractor self-performed work:
 - Overhead.....10%
 - Profit.....4.20%
- 2. Total aggregate limit of markup (OH&P) for Contractor and Subcontractors on modification work shall not exceed 25%. The NPS will not be responsible for allocation of percentages between contractor and subcontractors at any tier.
- 3. If Contractors form a partnership, partnership may only receive home office overhead and profit in same amount as an individual Contractor (refer to paragraph 1.3,E,1 above). It is the responsibility of the partners to decide on division of revenue.
- 4. Combined Increases and Decreases: On proposals involving both increases and decreases in the Contract Price, overhead and profit mark-ups are required on net increases and deducted on net decreases.
- 5. At no time can profit be calculated on Overhead or itself, it must be calculated on direct costs of work only.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 26 01 - CONTRACT MODIFICATION PROCEDURES

SECTION 01 27 00 – DEFINITION OF CONTRACT LINE ITEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. The intent of section 01 27 00 “Definition of Contract Line Item” is to explain, in general, what is and what is not included in a contract line item, and the limits or cut-off points where one item ends and another begins.
- B. If no contract line item exists for a portion of the work, include the costs in a related item.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF CONTRACT LINE ITEMS - BASE BID

- A. Contract Line Item No.0001: Base Bid.
 - 1. The Work includes but is not limited to removal of three (3) existing entrance kiosks, associated office building, and existing monument sign; removal and replacement of pavement adjacent to entrance buildings; construction of new office building and three (3) entrance kiosks (all wood framed buildings with concrete foundations and slab, cementitious siding, boardformed concrete veneer base, aluminum clad wood windows, standing seam metal roof); repair of historic masonry curb; Electrical work also includes coordination with Estes Park Power and Communications for an extension on the primary distribution and a new pad mounted transformer along with all related sitework. Communications work includes coordination with Lumen to relocate an existing pedestal and associated underground lines. A new wooden pole and conduit will also be provided for future NPS data infrastructure. Building work (office and kiosks) includes typical interior finishes: gyp board walls, paint, wall tile, sheet flooring, cabinetry, hollow metal exterior doors, wood interior doors, and a single user restroom. Supporting infrastructure shall include full security system, including multiple cameras and onsite server, power and data in all buildings, heating ventilation and cooling for all buildings, including positive pressurization of all kiosks. Site improvements include: new asphalt and reinforced concrete roadway paving, curbing, staff parking area, inlaid preformed plastic tape pavement markings, accessible sidewalks and curb cuts, concrete patio area, rumble strips, traffic alert signage, truncated dome pavers, and buried traffic counter loop.
 - 1. Measurement for payment will be on a lump sum basis as a single item of work.
 - 2. Payment will be made at the contract lump sum price.
- B. Contract Line Item No.0002: Rehabilitate Bighorn Ranger Station / Fall River Entrance Station Wastewater System (ROMO 199703).

1. The Work includes but is not limited to rehabilitation of sanitary lines with Cured In Place Pipe (CIPP) and replacement of the Onsite Wastewater Treatment System (OWTS).
2. Measurement for payment will be on a lump sum basis as a single item of work.
3. Payment will be made at the contract lump sum price.

C. Contract Line Item No.0003: Rehabilitate Bighorn Ranger Station / Fall River Entrance Water System (ROMO 249028).

1. The Work includes but is not limited to replacement of one (1) existing culverts, reconstruction of two (2) historic culvert headwalls, replacement of select existing waterlines; replacement of water treatment system and well pump. Electrical infrastructure for replaced water/wastewater treatment and pump. A spare communications conduit will also be provided for future fiber optic connectivity between the Bighorn Ranger Station and Fall River Entrance Office Building.
2. Measurement for payment will be on a lump sum basis as a single item of work.
3. Payment will be made at the contract lump sum price.

D. Contract Line Item No.0004: Not Used.

3.2 LIST OF CONTRACT LINE ITEMS – BID OPTION 1

A. Contract Line Item No.0005: Road Widening.

1. This item includes but is not limited to extending the additional lane from the base scope to the park boundary. This involves additional road construction (asphalt, striping) and associated grading, and revegetation. See also annotations on civil site plans.
2. Measurement for payment will be on a lump sum basis as a single item of work.
3. Payment will be made at the contract lump sum price.

3.3 LIST OF CONTRACT LINE ITEMS – BID OPTION 2

A. Contract Line Item No.0006: Pavement Striping.

1. This item includes but is not limited to alternate pavement striping and markings materials assuming inlaid pre-formed plastic tape pavement markings for roadway lane lines, edge lines, skip striping, gore striping, and related applications. Inlaid pre-formed thermoplastic pavement markings (i.e. ABAAS symbols, etc.) shall be included in the Base Bid.
2. Measurement for payment will be on a lump sum basis as a single item of work.
3. Payment will be made at the contract lump sum price.

3.4 LIST OF CONTRACT LINE ITEMS – BID OPTION 3

A. Contract Line Item No.0007: Monument Sign with Accessible Parking.

1. This item includes but is not limited to new monument sign (wood posts and panel, steel structure, concrete foundations, stone veneer base), asphalt pavement, retaining wall adjacent to parking lot, concrete paving, and a concrete valley cross pan adjacent to the parking area for the monument sign pull-off. Also included in this option is a stormwater

solution to route drainage from the roadside ditch beneath the pull-off and back into the roadside ditch to the east.

2. Measurement for payment will be on a lump sum basis as a single item of work.
3. Payment will be made at the contract lump sum price.

3.5 LIST OF CONTRACT LINE ITEMS – BID OPTION 4

A. Contract Line Item No.0008: Variable Message Sign.

1. This item includes but is not limited to wood posts, steel structure, concrete foundations, stone veneer base, trenching/conduit/power/communications to the sign, a supplemental conduit (laid in same trenching) for future electrical primary replacement, and electronically changeable message sign.
2. Measurement for payment will be on a lump sum basis as a single item of work.
3. Payment will be made at the contract lump sum price.

3.6 LIST OF CONTRACT LINE ITEMS – BID OPTION 5

A. Contract Line Item No.0009: Stone Veneer.

1. This item includes but is not limited to substitution of base bid boardform concrete veneer on the office and kiosk buildings for granite stone veneer.
2. Measurement for payment will be on a lump sum basis as a single item of work.
3. Payment will be made at the contract lump sum price.

3.7 LIST OF CONTRACT LINE ITEMS – BID OPTION 6

A. Contract Line Item No.0010: Weathering Steel Roofing and Elements.

1. This item includes but is not limited to substitution of the base bid prefinished standing seam metal roofing for standing seam bare “weathering” steel roofing. Also substitutes steel bollards, steel sidewalk grate, exposed steel columns and steel screens (at back of office building) with same element composed of weathering steel.
2. Measurement for payment will be on a lump sum basis as a single item of work.
3. Payment will be made at the contract lump sum price.

3.8 LIST OF CONTRACT LINE ITEMS – BID OPTION 7

A. Contract Line Item No.0011: Reset Granite historic CCC Curb.

1. This item includes but is not limited to salvaging and resetting the historic CCC curb on a stabilized base.
2. Measurement for payment will be on a lump sum basis as a single item of work.
3. Payment will be made at the contract lump sum price.

3.9 LIST OF CONTRACT LINE ITEMS – BID OPTION 8

A. Contract Line Item No.0012: Lightning Protection.

1. This item includes but is not limited to lightning protection for the new buildings.
2. Measurement for payment will be on a lump sum basis as a single item of work.
3. Payment will be made at the contract lump sum price.

3.10 LIST OF CONTRACT LINE ITEMS – BID OPTION 9

A. Contract Line Item No.0013: West Horseshoe Paving.

1. This item includes but is not limited to project close repaving of the West Horseshoe parking lot / pulloff area that will be used as a staging area.
2. Measurement for payment will be on a lump sum basis as a single item of work.
3. Payment will be made at the contract lump sum price.

3.11 LIST OF CONTRACT LINE ITEMS – BID OPTION 10

A. Contract Line Item No.0014: Culvert under Fall River Road.

1. The Work includes but is not limited to replacement of one (1) existing culvert and two (2) new concrete culvert headwalls constructed of integrally colored concrete with a boardformed finish, and associated grading and revegetation.
2. Measurement for payment will be on a lump sum basis as a single item of work.
3. Payment will be made at the contract lump sum price.

3.12 LIST OF CONTRACT LINE ITEMS – BID OPTION 11

A. Contract Line Item No.0015: Fall River Road Culvert Headwall Stone Veneer Finish.

1. This item includes but is not limited to a different culvert headwall design that includes stone veneer, stone wall cap, and the additional foundation width to support the stone veneer. Basis for design is:
 - a. 1/C4.7 for backup concrete retaining wall
 - b. 3/5.12 for structural veneer support ledge and top of wall configuration
 - c. 1/L2.4 for stone veneer detailing
 - d. 04 34 00 Stone Masonry spec for stone material and specifications
2. Measurement for payment will be on a lump sum basis as a single item of work.
3. Payment will be made at the contract lump sum price.

END OF SECTION 01 27 00 – DEFINITION OF CONTRACT LINE ITEMS

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 31 00 "Project Management and Coordination" includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
1. Construction Coordination.
 2. Division 01 Submittals.
 3. Requests for Information (RFIs).
 4. Project meetings.
 5. Environmental Coordination.
 6. Permits

1.2 CONSTRUCTION COORDINATION

- A. Coordination: Coordinate construction operations, included in different Sections, which depend on each other for proper installation, connection, and operation to ensure efficient and orderly installation of each part of the Work.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components with other Contractors to ensure maximum accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's Construction Schedule.
 2. Preparation of the Schedule of Values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Permit requirements.
 7. Pre-installation conferences.
 8. Project closeout activities.
 9. Commissioning activities.

1.3 SUBMITTALS

- A. Division 01 documents: The following items shall be submitted a minimum of one week prior to the Preconstruction Conference. Contracting Officer will notify Contractor of tentative date for the Pre-Construction Conference.
1. Letter designating Project Superintendent.
 2. Construction Schedule.
 3. A comprehensive breakdown of the Schedule of Values.
 4. Accident Prevention Plan/Safety Plan.
 5. A list of Subcontractors for this project.
 6. Written statements from subcontractors certifying compliance with applicable labor standard clauses.
 7. Satisfactory evidence of liability insurance coverage and workman's compensation for the Contractor and all subcontractors.
 8. Construction Staging and Phasing Plan.
 9. Traffic Control Plan.
 10. Storm Water Pollution Prevention Plan.
 11. Waste Management Plan.
 12. Quality Control Plan.
 13. Storm Water Pollution Prevention Plan.
 14. Indoor Air Quality (IAQ) Management Plan.
 15. Contractors Commissioning Plan.
 16. Historic Preservation Treatment Plan.
- B. All items listed must be provided to the Contracting Officer before the Pre-Construction Conference is held. If all of these documents have not been received one week prior to the scheduled Pre-Construction Conference date, the conference will be cancelled, Notice to Proceed will not be issued, and the Contracting Officer may consider other contractual remedies. A time extension will not be issued due to late submittals. Work shall not commence until written Notice to Proceed has been issued.
- C. See also Spec Section 01 33 23 "Submittal Procedures."

1.4 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Contracting Officer will return RFIs submitted by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in the work.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. RFI number, numbered sequentially.
 2. Project name.
 3. Contract number.
 4. Date.

5. Name of Contractor.
6. RFI subject.
7. Specification Section number and title and related paragraphs, as appropriate.
8. Drawing number and detail references, as appropriate.
9. Field dimensions and conditions, as appropriate.
10. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
11. Indication whether RFI impacts schedule and/or cost.
12. Contractor's signature.
13. Requested date for response.
14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

C. RFI Forms: Use RFI form included at the end of this Section or similar.

D. Contracting Officer's Action: Contracting Officer will review each RFI, determine action required, and respond. Contracting Officer will determine the critical nature of each RFI and issue a response accordingly.

1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Contracting Officer's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
2. Contracting Officer's action may include a request for additional information, in which case time for response will date from time of receipt of additional information.

1.5 PROJECT MEETINGS

A. Preconstruction Conference: Before start of construction, Contracting Officer will arrange an on-site meeting with Contractor. The meeting agenda will include the following as a minimum:

1. Roles & Responsibilities/ Lines of Authority.
2. Park rules and regulations.
3. Resolution of comments on required Division 01 documents.
4. Coordination of Subcontractors.
5. Labor law application.
6. Modifications.
7. Payments to Contractor.
8. Payroll reports.
9. Contract time.
10. Liquidated damages.
11. Notice to proceed.
12. Construction Schedule.

13. Correspondence procedures.
14. Acceptance/rejection of work.
15. Progress meetings.
16. Submittal procedures.
17. NPS Final Accessibility Inspection.
18. Waste Management.
19. Environmental requirements.
20. Project safety.
21. Display of Hotline posters.
22. Permit requirements.
23. As-constructed drawings/operation and maintenance (O&M) manuals.
24. Archeological monitoring
25. Notification to the park regarding the Bird Protection Acts
26. Coordination with park regarding access to the Bighorn Ranger Station Area
27. Visitor use of the entrance – daily park operations and procedures to close road
28. Contractor use of West Horseshoe Park parking lot as staging
29. Saturday, Sunday, holiday and night work – none permitted without CO approval
30. Reference materials.
31. Value engineering.
 - a. Submittals required prior to or at Preconstruction Conference:
 - 1) Letter designating the Project Superintendent.
 - 2) Proposed construction schedule.
 - 3) Schedule of values.
 - 4) Accident Prevention Plan/Safety Plan.
 - 5) A list of Subcontractors for this project.
 - 6) Written statements from subcontractors certifying compliance with applicable labor standard clauses.
 - 7) Satisfactory evidence of liability insurance coverage and workman's compensation for the Contactor and all subcontractors.
 - 8) Waste management plan.
 - 9) Quality control plan.
 - 10) Storm Water Pollution Prevention Plan.
32. Project closeout requirements

B. Progress Meetings: The Contracting Officer will schedule weekly meetings with the Contractor.

1. Attendees: In addition to Government Representatives, the Prime Contractor shall be present. At the request of the Contracting Officer or Prime Contractor, each Subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities may be represented at these meetings. All participants at the meeting shall be familiar with the Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. The meeting agenda will include the following:
 - a. Approval of minutes of previous meetings.
 - b. Submittal status.
 - c. Review of off-site fabrication and delivery schedules.
 - d. Requests for information (RFI) and other issues.

- e. Modifications.
 - f. Work in progress and projected.
 - g. Inspections of work in progress and projected.
 - h. Construction Schedule update (provide updated CPM).
 - i. Work anticipated to affect road access.
 - j. Status of Project Record Drawings and O&M manuals.
 - k. Safety Issues and/or Concerns
 - l. Archeological, Historic and Natural Resource Protection/Monitoring
 - m. Stormwater Control Issues and/or Concerns
 - n. Other business relating to work.
 - o. Permit requirements.
3. Contractor shall prepare agendas and meeting minutes documenting discussions.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Contracting Officer of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Possible conflicts.
 - i. Time schedules.
 - j. Weather limitations.
 - k. Compatibility of materials.
 - l. Temporary facilities and controls.
 - m. Space and access limitations.
 - n. Regulations of authorities having jurisdiction.
 - o. Testing and inspecting requirements.
 - p. Installation procedures.
 - q. Coordination with other work.
 - r. Protection of adjacent work.
 - s. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

1.6 ENVIRONMENTAL COORDINATION

- A. Contractor's Environmental Manager: Designate an on-site party responsible for overseeing the Contractor's conformance to environmental goals for the project and implementing procedures for environmental protection. The Contractor's Environmental Manager may also perform other duties.
1. Qualifications: Construction experience on projects of similar size and scope; with environmental procedures similar to those of this project; familiar with environmental regulations applicable to construction operations.
 2. Responsibilities: Responsibilities shall include:
 - a. Compliance with applicable Federal, State, and local environmental regulations, including maintaining required documentation.
 - b. Implementation of the Waste Management Plan (WMP).
 - c. Implementation of the Indoor Air Quality (IAQ) Management Plan.
 - d. Implementation of the Storm Water Pollution Prevention Plan (SWPPP), including procedures for containment of leaks and spills.
 - e. Present an overview of environmental issues and summarize site specific procedures relating to management plans at the Preconstruction conference.

1.7 PERMITS

- A. General:
1. Permits and Responsibilities: Contractor shall, without additional expense to the Government, be responsible for obtaining necessary licenses and permits, and for complying with Federal, State and municipal laws, codes, and regulations applicable to the performance of the work. Contractor shall also be responsible for damages to persons or property that occur as a result of Contractor's fault or negligence; and for materials delivered and work performed until completion and acceptance of the work.
 2. For the purpose of this contract, Contractor will not be considered an agent of the Government. Contractor shall comply with appropriate Federal, State and local laws.
- B. Government Furnished Permits: During development of the project's design, permits listed below were negotiated and agreed to by the Government. Terms and provisions of these permits shall be adhered to for the duration specified in each permit.
1. A permit will be acquired for the Onsite Wastewater Treatment System (OWTS). Obtain the approved permit from the Contracting Officer prior to the start of construction. The Agency Having Jurisdiction for this permit is the Larimer County Health Department.
 2. A permit will be acquired for Traffic Control – Special Use Permit. Obtain the approved permit from the Contracting Officer prior to the start of construction. The Agency Having Jurisdiction for this permit is the Colorado Department of Transportation (CDOT).
 3. A permit will be acquired for Traffic Control – Right of Way (ROW) Permit. Obtain the approved permit from the Contracting Officer prior to the start of construction. The Agency Having Jurisdiction for this permit is the Town of Estes Park.

4. A permit will be acquired for Clean Water Act (CWA) Section 404. Obtain the approved permit from the Contracting Officer prior to the start of construction. The Agency Having Jurisdiction for this permit is the US Army Corps of Engineers.
- C. Contractor Provided Permits: Permits listed below were identified during the design process as likely to be required based on typical means and methods of construction. The list is provided to assist Contractor in determining which permits will be required for contract's chosen means and methods. The list shall not be considered complete; it is the Contractors' responsibility to determine means and methods and obtain required permits. Contractor shall obtain all permits required to legally conduct work.
1. Stormwater Pollution Prevention Permit – Colorado Department of Public Health and Environment (CDPHE).
 2. Dewatering Permit - Colorado Department of Public Health and Environment (CDPHE)
 3. National Pollutant Discharge Elimination System (NPDES) – U.S. Environmental Protection Agency (U.S. EPA)
- D. Coordination with Agency(ies) with Jurisdiction Issuing Permits
1. Coordination: Contact the Agency(ies) with Jurisdiction as needed and sufficiently in advance to avoid delaying work: Coordinate meetings, reporting requirements, inspections, and other requirements.
- E. Administrative Procedures:
1. Coordinate scheduling and timing of required administrative provisions of project permits with Agency(ies) with Jurisdiction, Construction Manager, and Park to avoid conflicts.
 2. Supply needed information to Agency(ies) with Jurisdiction issuing permits, pay fees required and provide material needed to comply with permit's conditions and provisions.
 3. Upload permits to NPS/DSC management software website when permits are obtained.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

REQUEST FOR INFORMATION # _____

Project:

Contract No.:

Date:

To:

cc:

From:

Subject:

Please provide the following information or clarification:

Impact to Schedule (Y or N) _____

Impact to Cost (Y or N) _____

Response required by ____________

Date:

To:

From:

Subject: Response to RFI No _____

SECTION 01 32 16 – CONSTRUCTION SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 32 16 “Construction Schedule” consists of Construction Schedule requirements including but not limited to the following:
1. Schedule of Values.
 2. Construction Schedule Requirements.
 3. Construction Schedule Updates.
- B. Purpose: The purpose of the Construction Schedule is to ensure adequate planning, coordination, scheduling, and reporting during execution of the work by the Contractor. The Construction Schedule will assist the Contractor and Contracting Officer in monitoring the progress of the work, evaluating proposed changes, and processing the Contractor's monthly progress payment.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
 2. Predecessor Activity: An activity that precedes another activity in the network.
 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Float: The measure of leeway in starting and completing an activity.
1. Float: Float is not for the exclusive use or benefit of either the Government or the Contractor but is jointly owned.
 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

1.3 SUBMITTALS

- A. Schedule of Values: After contract award and before the Pre-Construction conference submit a schedule of dollar values based on the Contract Price Schedule.
- B. Construction Baseline Schedule: After contract award and before the Pre-Construction conference, submit baseline schedule, showing entire schedule for entire construction period.
- C. Construction Schedule Updates: On or before the 7th day preceding the progress payment request date, submit estimates of the percent completion of each schedule activity and necessary supporting data.
- D. Construction Schedule Revisions: For each Construction Schedule revision submit revised schedule demonstrating how the Contractor proposes to incorporate a modification, change, delay or Contractor request.

1.4 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate Contractors.
- B. Coordinate Construction Baseline Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. In developing the Construction Baseline Schedule, ensure that the Subcontractor's work at all tiers, as well as the prime Contractor's work, is included and coordinated.
 - 2. Secure time commitments for performing critical elements of the Work from parties involved.
 - 3. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SCHEDULE OF VALUES

- A. Breakdown each lump-sum item into component parts of work for which progress payments may be requested. The total costs for the component parts of work shall equal the contract price for that lump-sum item. The Contracting Officer may request data to verify accuracy of dollar values. Include mobilization, general condition costs, overhead and profit in the total dollar value of unit price items and in the component parts of work for each lump-sum item. Do not include mobilization, general condition costs, overhead or profit as a separate item.
- B. Do not break down unit price items. Use only the contract price for unit price items.
- C. The total cost of all items shall equal the contract price. The Schedule of Values will form the basis for progress payments.

- D. An acceptable Schedule of Values shall be agreed upon by the Contractor and Contracting Officer before the first progress payment is processed.

2.2 CONSTRUCTION SCHEDULE REQUIREMENTS

- A. Construction Baseline Schedule: Prepare Construction Baseline Schedule using a computerized, cost and resource-loaded, time-scaled CPM network analysis diagram for the Work.
 - 1. Develop and finalize Construction Baseline Schedule so it can be accepted for use no later than 30 days after date established for the Notice of Award.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Governments acceptance of the schedule.
 - 2. Establish procedures for monitoring and updating Construction Baseline Schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
- B. Construction Baseline Schedule Preparation: Prepare a list of all activities required to complete the Work. Prepare a skeleton network to identify probable critical paths.
 - 1. Activities: Indicate the estimated duration, sequence requirements, and relationship of each activity in relation to other activities.
 - 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 - 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 - 4. The Construction Baseline Schedule as developed shall show the sequence and interdependence of activities required for complete performance of the work. Ensure all work sequences are logical and the Construction Baseline Schedule shows a coordinated plan of the work.
 - 5. Consider seasonal weather conditions in planning and scheduling all work influenced by high and low ambient temperatures, wind, or precipitation to ensure completion of all work within the contract time.
 - 6. Time Frame: Proposed duration assigned to each activity shall be the Contractor's best estimate of time required to complete the activity considering the scope and resources planned for the activity.
 - a. An early finish date may be shown but the late finish date must be the same date as the last day of the contract period.
 - b. Contract completion date shall not be changed by submission of a schedule that shows an early completion date.
 - c. The Contractor shall limit use of lead or lag durations between schedule activities.
 - d. Activity Duration: Define activities so no activity is longer than 15 days, except for non-construction activities including mobilization, shop drawings and submittals, fabrication and delivery of materials and equipment.

- e. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 calendar days, as separate activities in the schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery. DD Note: This is the start of this list
 - 1) Potential base bid long lead items: light fixtures, PVC conduit, outdoor VRF condensing units, indoor energy recovery ventilation unit, make-up air unit.
 - 2) Potential bid option long lead items: fiber optic cable.
 - f. Submittal Review Time: Include review and re-submittal times indicated. Coordinate submittal review times in Construction Baseline Schedule.
 - g. Startup and Testing Time: Include no less than one (1) day for startup and testing and one (1) day for commissioning activities.
 - h. Substantial Completion: Allow time for Government administrative procedures necessary for certification of Substantial Completion as specified Section 01 77 00 "Closeout Procedures".
7. Constraints: Include constraints and work restrictions indicated in the Contract Documents, as follows in schedule, and show how the sequence of the Work is affected.
- a. Work Restrictions: Show the effect of the following items on the schedule:
 - 1) Coordination with parallel areas of construction.
 - 2) Limitations of continued occupancy of Bighorn Ranger Station area.
 - 3) Uninterruptible services.
 - 4) Use of premises restrictions.
 - 5) Seasonal variations.
 - 6) Maintaining vehicular access through site.
 - 7) Shift of vehicular access as construction progresses.
8. Milestones: Include milestones indicated in the Contract Documents in schedule including, but not limited the following milestones:
- a. Notice to Proceed
 - b. Substantial Completion
 - c. Shifting of Vehicular Access Route and Temp Kiosk Location (may occur more than once).
 - d. Final Completion.
- C. Joint Review, Revision, and Acceptance:
- 1. Within seven calendar days of receipt of the Contractor's proposed Construction Baseline Schedule, the Contracting Officer and Contractor shall meet for joint review, correction, or adjustment of the initial Construction Baseline Schedule. Any areas which, in the opinion of the Contracting Officer, conflict with timely completion of the project shall be subject to revision by the Contractor.
 - 2. Within seven calendar days after the joint review between the Contractor and Contracting Officer, the Contractor shall revise and resubmit the Construction Baseline Schedule in accordance with agreements reached during the joint review.
 - 3. In the event the Contractor fails to define any element of work, activity, or logic, and the Contracting Officer review does not detect this omission or error, such omission or error,

when discovered by the Contractor or Contracting Officer, shall be corrected by the Contractor within seven calendar days and shall not affect the contract period.

4. Upon acceptance of the Construction Baseline Schedule by the Contracting Officer, save the schedule as a baseline and update on a monthly basis. The construction schedule update will be used to evaluate the Contractor's monthly applications for payment based upon information developed at the monthly Construction Schedule update meeting.

- D. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.

PART 3 - EXECUTION

3.1 CONSTRUCTION SCHEDULE UPDATES

- A. Progress Meeting Updates: Provide updated schedule information before each weekly progress meeting.

1. Issue updated schedule concurrently with the report of each such meeting. Incorporate construction progress into the currently accepted schedule in a timely manner.

- B. Monthly Schedule Updates:

1. General: Update the Construction Schedule on a monthly basis to reflect actual construction progress and activities throughout the entire contract period and until project substantial completion. The status date of each schedule update shall be the 7th day preceding the progress payment request date.
2. Procedure: The Contractor shall meet with the Contracting Officer each month to review actual progress made through the status date of the Construction Schedule update, including dates activities were started and/or completed and the percentage of work completed on each activity started and/or completed.
3. As the Work progresses, indicate Actual Completion percentage for each activity
4. Progress Payments: The monthly updating of the currently accepted Construction Schedule shall be an integral part of the process upon which progress payments will be made under this contract. If the Contractor fails to provide schedule updates or revisions, then a portion of the monthly payment may be retained until such corrections have been made.

- C. Distribution: Distribute copies of accepted schedule to Contracting Officer, Construction Management Representative, Subcontractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

- D. Construction Schedule Revisions:

1. Required Revisions: If, as a result of the monthly schedule update, it appears the currently accepted Construction Schedule no longer represents the actual prosecution and

progress of the work, the Contracting Officer will request, and the Contractor shall submit, a revision to the Construction Schedule. The Contractor may also request reasonable revisions to the currently accepted Construction Schedule in the event the Contractor's planning for the work is revised. If the Contractor desires to make changes, the Contractor shall notify the Contracting Officer in writing, stating the reason for the proposed revision. Accepted revisions will be incorporated into the currently accepted Construction Schedule for the next monthly schedule update.

2. Procedure: If revision to the Construction Schedule is contemplated, the Contractor or Contracting Officer shall so advise the other in writing at least seven calendar days prior to the next monthly schedule update meeting, describing the revision and reasons for the revision. Government-requested revisions to the Construction Schedule will be presented in writing to the Contractor, who shall respond in writing within seven calendar days.

END OF SECTION 01 32 16 – CONSTRUCTION SCHEDULE

SECTION 01 32 33 – PHOTO DOCUMENTATION FOR HISTORIC PRESERVATION PROJECTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 32 33 “Photo Documentation for Historic Preservation Projects” includes administrative and procedural requirements for the following:
 - 1. Existing Condition images.
 - 2. Mid construction images.
 - 3. Post construction images.
 - 4. Photographs for all three periods are required for all historic preservation portions of the work.
- B. Work to be documented with this method:
 - 1. Historic CCC Era Headwalls (Two) at Bighorn Ranger Station Area Culvert
 - 2. Historic CCC Era Stone Curb at pullout west of entrance station
 - 3. Historic CCC Era Stone Steps/Curb at back of Bighorn Ranger Station
- C. See Division 01 Section 01 77 00 "Closeout Procedures" for a complete listing of closeout documents.

1.2 SUBMITTALS

- A. Existing Conditions and Construction Images: Submit images electronically within seven days of taking the image. Include the following for each:
 - 1. Include Date, time and number (sequentially number all images) in filename.
 - 2. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - 3. Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 4. Pre- construction
 - 5. Submittal of Existing Conditions photos will be reviewed by the Contracting Officer.
 - a. Approval by CO is required before proceeding with demolition.
- B. Closeout: Submit a complete set of digital image electronic files as a Project Record Document. Submit on either a Compact Disc (CD) or Digital Video Disc (DVD).
 - 1. Provide an index as a separate file on the Disc. List each image as a file name with number, date, and time. Include description and or vantage point image was taken.
 - 2. Submit images that have the same aspect ratio as the sensor, un-cropped.

PART 2 - PRODUCTS

2.1 FORMAT REQUIREMENTS

- A. Media: CD-R Archival Gold or DVD-R Archival Gold
- B. Media Labels: Archival CD/DVD labeling markers, archival labels, or direct print CD
- C. Images: Provide sRGB color images in JPEG format. Minimum sensor size of 6 mega pixels, and at an image resolution of not less than 3200 by 2400 pixels.
- D. Photos must meet National Register standards for quality:
https://www.nps.gov/subjects/nationalregister/upload/Photo_Policy_update_2013_05_15_508.pdf

PART 3 - EXECUTION

3.1 CONSTRUCTION IMAGES

- A. General: Take digital images using the maximum range of depth of field, and that are in focus, to clearly show the Work. Images with blurry or out-of-focus areas will not be accepted.
- B. Existing Condition Images: Before commencement of salvage and rehabilitation, take color digital images of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Contracting Officer.
 - 1. Flag relevant construction limits in view before recording construction images.
 - 2. Take minimum eight (8) separate images of each area of work (CCC curb and culvert headwall) to show existing conditions adjacent to property before starting the Work.
 - 3. Take minimum eight separate images of existing buildings in Bighorn Ranger Station area to accurately record physical conditions at start of construction.
- C. During Construction Images: Take minimum eight (8) color, digital images at midpoint of rehabilitation and construction effort. Select vantage points to show status of construction and progress since last images were taken.
 - 1. For culvert, photograph when all stones have been salvaged from original location.
- D. Post Construction Images: Take minimum eight (8) color, digital images at close of rehabilitation and construction effort with the cutoff date associated with Application for Payment. Select vantage points to show status of construction and progress since last images were taken.
- E. Additional Images: Contracting Officer may issue requests for additional images, in addition to periodic Construction images specified.
 - 1. Three days notice will be given, where feasible.
 - 2. In emergency situations, take additional images within 24 hours of request.

3. Circumstances that could require additional images include, but are not limited to, the following:
 - a. Immediate follow-up when on-site events result in construction damage or losses.
 - b. Images to be taken at fabrication locations away from Project site.
 - c. Substantial Completion of a major phase or component of the Work.
 - d. Extra record images at time of final acceptance.

END OF SECTION 01 32 33 – PHOTO DOCUMENTATION FOR HISTORIC PRESERVATION PROJECTS

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SECTION 01 33 23 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 33 23 “Submittal Procedures” includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples and other submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written, graphic information, and physical samples that require Government’s responsive action.
- B. Informational Submittals: Written information that does not require Government’s responsive action. Submittals may be rejected for not complying with requirements.

1.3 GENERAL SUBMITTAL PROCEDURES

- A. General: Prepare and submit submittals required by individual specification sections. Types of submittals are indicated in individual specific sections.
 - 1. Contracting Officer reserves the right to require submittals in addition to those called for in individual sections.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Review them for legibility, accuracy, completeness, and compliance with Contract Documents.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Contracting Officer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Submittal List: A submittal list has been attached to the end of this specification section. The intent is to provide an overall summary of submittal requirements and not a comprehensive list. The requirements of the individual specification sections, terms and conditions of the Contract still apply regardless of what is shown on the submittal list.
- D. Processing Time: Allow enough time for submittal review, including time for re-submittals, as follows. Time for review shall commence on Contracting Officer’s receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including re-submittals.

1. Action Submittals
 - a. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.
 - b. Re-submittal Review: Allow 15 days for review of each re-submittal.
 2. Informational submittals
 - a. Review: Allow 10 days for review of each submittal.
- E. Approved Equals:
1. For each item proposed as an "approved equal," submit supporting data, including:
 - a. Drawings and samples as appropriate.
 - b. Comparison of the characteristics of the proposed item with that specified.
 - c. Changes required in other elements of the work because of the substitution.
 - d. Name, address, and telephone number of vendor.
 - e. Manufacturer's literature regarding installation, operation, and maintenance, including schematics for electrical and hydraulic systems, lubrication requirements, and parts lists. Describe availability of maintenance service, and state source of replacement materials.
 2. A request for approval constitutes a representation that Contractor:
 - a. Has investigated the proposed item and determined that it is equal or superior in all respects to that specified.
 - b. Will provide the same warranties for the proposed item as for the item specified.
 - c. Has determined that the proposed item is compatible with interfacing items.
 - d. Will coordinate the installation of an approved item and make all changes required in other elements of the work because of the substitution.
 - e. Waives all claims for additional expenses that may be incurred as a result of the substitution.
- F. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. CM-16E Transmittal Form: All material submittals shall be transmitted using National Park Service form CM-16E. (This form can be downloaded from <https://www.nps.gov/dscw/publicforms.htm>) No action will be taken on a material submittal item unless accompanied by the transmittal form.
 - a. Complete the Contractor portion (indicated in white) on form CM-16E.
 - b. Provide a certified digital signature on form CM-16E where indicated.
 - c. Attach all related documents in PDF format.
 2. Name file with submittal number or other unique identifier, including revision identifier.
- G. Hardcopy Submittals:
1. Hardcopy submittals will be accepted in lieu of electronic submittals.

2. Use the same transmittal form as specified above.
3. Complete all sections as specified above.
4. Signature and attached related documents do not need to be electronic format.
5. Number of copies:
 - a. Submit four copies, unless otherwise indicated. Contracting Officer will return one copy. Retain copy as a Project Record Document.

H. Identification: Submittal number or other unique identifier, including revision identifier.

1. Submittal number shall use a sequential number (e.g., .001). Re-submittals shall include an alphabetic suffix after another decimal point (e.g., .001.A).

I. Re-submittals: Make re-submittals using the same process used with the initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in the title block on the CM-16E and clearly indicate the extent of revision.
3. Re-submit submittals until they are marked “Approved” or “Approved with Notations”.

J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, and others as necessary for performance of construction activities.

K. Use for Construction: Use only final submittals with mark indicating “Approved” or “Approved with Notations”. Ensure all notations have been incorporated and, at a minimum, keep one copy of the final approved submittal on site for use during construction.

1.4 CONTRACTOR'S USE OF CAD FILES

A. General: At Contractor's written request, copies of CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:

1. Files will be provided as is; no format or other changes to files or changes to the objects in the drawing will be done by the Government.
2. After a written request is received from the contractor for CAD files, the project engineer will provide coordinate information and electronic drawings in AutoCAD Civil3D 2018 format within 14 days.
 - a. If files are provided by the design team, contractor may be required to fill out an electronic file release form prior to provision of the files.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts: Submit only pertinent pages; mark each page of standard printed data to identify specific products proposed for use.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions: When Contract Documents require compliance with manufacturer's printed instructions, provide one complete set of instructions to Contracting Officer and keep another complete set of instructions at the project site until substantial completion.
 - d. Wiring diagrams showing factory-installed wiring.
 - e. Printed performance curves.
 - f. Operational range diagrams.
 - g. Compliance with specified referenced standards.
 - h. Testing by recognized testing agency.
 4. Submit product data in PDF file format or hardcopy.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Notation of coordination requirements.
 - j. Notation of dimensions established by field measurement.
 - k. Relationship to adjoining construction clearly indicated.
 - l. Seal and signature of professional engineer if specified.
 - m. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 2. Submit shop drawings in PDF file format or hardcopy.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:

- a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Submittal Number and title of appropriate Specification Section.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Contracting Officer will return submittal with options selected.
 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit two sets of Samples. Contracting Officer will retain one Sample set; remainder will be returned. Retain Sample set as a Project Record Sample.
- D. Construction Materials: The Contractor is encouraged to submit for approval products made out of recycled or environmentally responsible material. Every effort will be made by the National Park Service to approve these materials.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by individual Specification Sections.
 1. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 2. Informational submittals that do not comply with the requirements specified in the Contract Documents will be rejected and one copy will be returned.
- B. Coordination Drawings: Comply with requirements specified in Section 01 31 00 "Project Management and Coordination."

- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and Contracting Officers, and other information specified.
- D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- E. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- G. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- J. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- K. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- L. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- M. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- N. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

- O. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."
- P. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- Q. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer.
- R. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
 - 1. Statement on condition of substrates and their acceptability for installation of product.
 - 2. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions.

3.2 CONTRACTING OFFICER'S ACTION

- A. General: Submittals will be disapproved without technical review if identification information is missing; an incorrect format of submittals is provided; the transmittal form is incorrectly filled out; submittals are not coordinated; or submittals do not show evidence of Contractor's approval.
 - 1. Any work done or orders for materials or services placed before approval shall be at the Contractor's own risk.
- B. Action Submittals: Contracting Officer will review each submittal, generate comments on corrections or modifications required, and indicate the appropriate action on the CM-16E Transmittal Form. The submittal will be marked in one of three ways as defined below:
 - 1. APPROVED: Acceptable with no corrections.

2. APPROVED WITH NOTATIONS: Minor corrections or clarifications required. All comments are clear and no further review is required. The Contractor shall address all review comments when proceeding with the work.
 3. DISAPPROVED - RESUBMIT: Rejected as not in accordance with the contract or as requiring major corrections or clarifications. The Contracting Officer will identify the reasons for disapproval. The Contractor shall revise and resubmit with changes clearly identified.
- C. Informational Submittals: Contracting Officer will review each submittal and will either accept or reject it.
- D. Partial submittals are not acceptable, will be considered non-responsive, and will be returned without review.

END OF SECTION 01 33 23 - SUBMITTAL PROCEDURES

Submittal List with Review Estimate Template

National Park Service (NPS) - Denver Service Center (DSC) | 1-27-21

SUBMITTAL LIST											ACTION SUBMITTAL REVIEW ESTIMATE						
Park Acronym/Project Management Information System (PMIS) Number:										ROMO 160755/199703/249028/318223	(Complete this portion for Architect / Engineer (A/E) construction service task order negotiation.) ARCHITECT / ENGINEER REVIEW TIME (Indicate in whole or partial hours.)						
Project Title:										Replace Undersized Entrance Station at Fall River Entrance							
SUBMITTAL			REQUIREMENTS (Indicate with X)														
SPECIFICATION SECTION	PARAGRAPH NUMBER	DESCRIPTION	INFORMATIONAL				ACTION				ARCHITECT	CIVIL ENGINEER	STRUCTURAL ENGINEER	MECHANICAL ENGINEER	ELECTRICAL ENGINEER	PROJECT MANAGER COORDINATION	LANDSCAPE ARCHITECT
			CERTIFICATIONS OR LABORATORY TESTS	REPORTS OR CALCULATIONS OR PLAN	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	SAMPLES	SHOP DRAWINGS	MOCKUP	MANUFACTURER DATA AND INSTRUCTIONS							
01 31 00	1.3 A	Division 01 Documents		X													
01 32 16	1.3	Schedule of Values, Baseline Schedule, Schedule Updates, and Revisions															X
01 32 33	1.2A	Construction Images															X
01 35 13	1.3	Daily Work Schedule															X
01 35 23	1.3	Accident Prevention Plan/Safety Plan															X
01 35 91	1.3	Historic Preservation Treatment Program															X
	1.3	Alternative Methods and Materials															X
	1.3	Product Data										X					
	1.3	Restoration Specialist Qualifications															X
	1.3	Photographs or Videotape															X
01 40 00	1.4	Quality Control Plan															X
	1.4	Qualification Data					X										
	1.4	Contractor's Quality Control Daily Reports		X													
	1.4	Test Reports		X													
	1.4	Accessibility Inspection Report		X													
	1.4	Off-site Inspection Reports		X													
	1.4	Permits, Licenses and Certificates															
01 57 13	1.4	Submit manufacturer's published descriptive literature and complete specifications for geotextiles and erosion control fabric.									X						
01 57 13	1.4	Permits: Submit a copy of the Construction Dewatering Permit from the Colorado Department of Public Health and Environment, Water Quality Control Division.					X										
01 57 13	1.4	Stormwater Management Report		X													
01 57 19.11	1.4	Indoor Air Quality Management Plan															X
01 57 19.11	1.4	Product Data		X							X						
01 57 19.11	1.4	Inspections and Test Reports		X							X						
01 73 29	1.3	Product Data									X						
01 73 40	1.2	Certificates, Landfill Receipts, Certified As-Build Surveys, Quantity Surveys	X														
01 74 19	1.4	Waste Management Plan									X						
	1.4	Landfill and Incinerator Disposal Records					X										
01 91 14	1.6	Two week look ahead schedule, Certificates of Readiness, Commissioning Plan, Prefunctional checklists, Lists of equipment, Deficiency Report and Resolution Record.															
02 41 13	1.4	Shop Drawings with Schedule		X					X								
02 41 16	1.6	Predemolitions Photographs or Video															
02 81 01	1.3	Permit Profile of Storage/Facility, Bills of Lading/Manifests, Closeout Documentation		X			X										X
02 82 13	1.7	Permits, Insurances, Safety Submittals, Abatement Plan, Sampling, Closeout Report		X			X										X
02 83 13	1.7	Safety Submittals, Sampling Plan, Management/Disposal Plan, Sampling and Analysis		X			X										X
02 84 16	1.7	Permits, Certifications, Schedule, Documentation of Procedures, Disposal Documentation		X			X										X
03 30 00	1.04A	Product Data				X					X						

SUBMITTAL LIST

**ACTION SUBMITTAL
REVIEW ESTIMATE**

Park Acronym/Project Management Information System (PMIS) Number: ROMO 160755/199703/249028/318223

(Complete this portion for Architect / Engineer (A/E) construction service task order negotiation.)

Project Title: Replace Undersized Entrance Station at Fall River Entrance

ARCHITECT / ENGINEER REVIEW TIME
(Indicate in whole or partial hours.)

SUBMITTAL			REQUIREMENTS (Indicate with X)										ARCHITECT / ENGINEER REVIEW TIME (Indicate in whole or partial hours.)						
SPECIFICATION SECTION	PARAGRAPH NUMBER	DESCRIPTION	INFORMATIONAL				ACTION						ARCHITECT	CIVIL ENGINEER	STRUCTURAL ENGINEER	MECHANICAL ENGINEER	ELECTRICAL ENGINEER	PROJECT MANAGER COORDINATION	LANDSCAPE ARCHITECT
			CERTIFICATIONS OR LABORATORY TESTS	REPORTS OR CALCULATIONS OR PLAN	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	SAMPLES	SHOP DRAWINGS	MOCKUP	MANUFACTURER DATA AND INSTRUCTIONS	OTHER								
03 30 00	1.04B	Design Mixtures								X									
03 30 00	1.04C	Reinforcing Steel Shop Drawings								X									
03 30 00	1.04D	Board Form Shop Drawings								X									
03 30 00	1.04E	Material Test Reports	X																
03 30 00	1.04F	Material Certificates	X																
03 30 00	1.05G	Wall Mock-Ups									X								
03 30 00	1.04H	Placement Notification					X												
03 30 00	1.04I	Proposed Location of Saw Cut Joints		X						X									
03 45 00	1.4	Product Data											X						
	1.4	Design Mixtures									X								
	1.4	Shop Drawings									X								
	1.4	Samples							X										
	1.4	Delegated Design Submittal								X									
	1.5	Qualification Data, Material Certificates, Material Test Reports, Preconstruction Test Reports	X	X	X														
	1.6	Mockups									X								
04 01 40.91	1.2	Qualifications				X													X
	1.2	Restoration Program		X						X									
	1.2	Product Data				X							X						
	1.2	Samples							X										
	1.2	Mortar Samples							X										
	1.3	Field Constructed Mock-ups									X								
04 34 00	1.2 B	Testing of Mortar Mixes	X																
	1.2 D	Testing	X																
	1.3B	Stone Samples							X										X
	1.3D	Product Data				X							X						
	1.3	Stone Supplier																	
	1.3	Manufacturer's Literature and Product Data																	
	1.3	Construction Procedures									X								
	1.3F	Shop Drawings									X								
	1.3G	Mortar Samples							X										
	1.3H	Pointing and Repointing Samples							X	X									
	1.3K	Reference Standards				X													
	1.5	Field Constructed Mock-ups (multiple types)									X								
	1.4A	Product Data							X										
	1.4B	Shop Drawings									X								
05 12 00	1.4A	Product Data	X																
05 12 00	1.4B	Shop Drawings									X								
05 12 00	1.4C	Erection Drawings		X							X								
05 12 00	1.4D	Material Test Reports	X																
05 12 00	1.4E	Certifications	X																
05 12 00	1.3	Product Data	X																
05 12 00	1.3	Shop Drawings	X								X								
05 50 00	1.3	Delegated Design Submittal											X						

SUBMITTAL LIST

**ACTION SUBMITTAL
REVIEW ESTIMATE**

Park Acronym/Project Management Information System (PMIS) Number: ROMO 160755/199703/249028/318223

(Complete this portion for Architect / Engineer (A/E) construction service task order negotiation.)

Project Title: Replace Undersized Entrance Station at Fall River Entrance

ARCHITECT / ENGINEER REVIEW TIME
(Indicate in whole or partial hours.)

SPECIFICATION SECTION	PARAGRAPH NUMBER	SUBMITTAL DESCRIPTION	REQUIREMENTS (Indicate with X)										ARCHITECT	CIVIL ENGINEER	STRUCTURAL ENGINEER	MECHANICAL ENGINEER	ELECTRICAL ENGINEER	PROJECT MANAGER COORDINATION	LANDSCAPE ARCHITECT		
			INFORMATIONAL					ACTION													
			CERTIFICATIONS OR LABORATORY TESTS	REPORTS OR CALCULATIONS OR PLAN	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	SAMPLES	SHOP DRAWINGS	MOCKUP	MANUFACTURER DATA AND INSTRUCTIONS	OTHER										
	1.3A	Product Data								X											
	1.3C	Shop Drawings								X											
06 10 00	1.3A	Product Data			X							X									
06 10 00	1.4A	Material Certification	X																		
06 10 63	Exterior Rough Carpentry								X	X											
06 10 63	1.4A	Material Certification			X																
06 10 63	1.4B	Certificates of Inspection	X																		
06 10 63	1.4C	Evaluation Report			X								X								
06 10 63	1.5C	Shop Drawings	X																		
06 10 63	1.3A	Product Data		X									X								
06 10 63	1.3B	Shop Drawings								X											
06 17 00	Shop Fabricated Structural Wood																				
06 17 00	1.3A	Product Data			X																
06 17 00	1.3B	Shop Drawings								X											
06 17 53	Shop Fabricated Wood Trusses																				
06 17 53	1.3C	Delegated Design Submittal		X						X											
06 17 53	1.4A	Qualifications	X																		
06 17 53	1.4B	Material Certification	X																		
06 17 53	1.4C	Certificates	X																		
06 17 53	1.3A	Product Data											X								
06 17 53	1.3B	Shop Drawings		X						X											
06 20 23	1.3A	Product Data			X																
	1.3B	Shop Drawings							X												
06 41 16	1.4A	Qualifications																			
	1.2A	Product Data								X											
	1.3A	Product Data	X																		
07 11 13	1.4A	Certification																		X	
07 21 00	1.2A	Product Data																		X	
	1.3A	Field quality-control test reports.	X																		
07 21 19	1.4A	Qualifications																		X	
	1.3A	Product Data		X																	
	1.3B	Shop Drawings	X																		
07 25 00	1.3C	Mock Up																		X	
	1.4A	Product Data								X											
	1.4B	Shop Drawings									X									X	
07 41 13.16	1.4C	Samples for Initial Selection											X								
	1.4D	Samples for Verification								X											
	1.5	Qualifications, Warranties							X												
	1.4A	Product Data							X												
	1.4B	Shop Drawings	X		X																
07 42 93	1.4C	Samples for Initial Selection											X								
	1.5	Warranty, Maintenance Data.								X											
	1.5A	Product Data							X												
	1.5B	Samples for Initial Selection			X																

SUBMITTAL LIST

**ACTION SUBMITTAL
REVIEW ESTIMATE**

Park Acronym/Project Management Information System (PMIS) Number: **ROMO 160755/199703/249028/318223**

(Complete this portion for Architect / Engineer (A/E) construction service task order negotiation.)

Project Title: **Replace Undersized Entrance Station at Fall River Entrance**

ARCHITECT / ENGINEER REVIEW TIME
(Indicate in whole or partial hours.)

SUBMITTAL			REQUIREMENTS (Indicate with X)									ARCHITECT / ENGINEER REVIEW TIME (Indicate in whole or partial hours.)						
SPECIFICATION SECTION	PARAGRAPH NUMBER	DESCRIPTION	INFORMATIONAL				ACTION					ARCHITECT	CIVIL ENGINEER	STRUCTURAL ENGINEER	MECHANICAL ENGINEER	ELECTRICAL ENGINEER	PROJECT MANAGER COORDINATION	LANDSCAPE ARCHITECT
			CERTIFICATIONS OR LABORATORY TESTS	REPORTS OR CALCULATIONS OR PLAN	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	SAMPLES	SHOP DRAWINGS	MOCKUP	MANUFACTURER DATA AND INSTRUCTIONS	OTHER							
07 46 46	1.6	Warranty																
	1.7	Maintenance Data.						X										
	1.9	Mockup	X															
	1.4A	Product Data			X													
	1.4B	Shop Drawings								X								
07 62 00	1.4C/D	Samples																
	1.04B/C	Product Data							X									
	1.04D	Color Cards for Selection						X										
07 92 00	1.04E	Preconstruction Lab Test Reports																
	1.4A	Product Data						X										
	1.4B	Shop Drawings	X															
08 11 13	1.4C	Samples for Initial Selection																
	1.2A	Product Data							X									
	1.2B	Shop Drawings						X										
08 14 16	1.3	Warranty																
	1.2A	Product Data							X									
	1.3A	Product Data			X													
08 31 13	1.3B	Shop Drawings																
08 50 00	1.3C	Samples																
	1.4	Warranty							X									
	1.03B1	Product Data						X										
	1.03B2	Riser and Wiring Diagrams			X													
08 71 00	1.03B3	Door Hardware Schedule																
	1.03B4	Key Schedule								X								
	1.03C	Warranties								X								
	1.03D	Operations and Maintenance Data								X								
	1.2A	Product Data			X													
	1.3A	Product Data			X													
09 29 00	1.3C	Samples																
09 30 13	1.3A	Product Data																
	1.3B	Shop Drawings						X										
09 65 43	1.3C	Samples																
	1.4A	Maintenance Data.							X									
	1.3A	Product Data						X										
	1.3B	Samples			X													
09 91 13	1.3A	Product Data																
	1.3B	Samples						X										
09 91 23	1.2A	Product Data																
	1.2B	Samples for Initial Selection						X										
09 93 00	1.3C	Samples for Verification																
09 93 00	1.3D	Product List						X										
09 93 00	1.4A	Mock Up						X										
09 93 00	1.3A	Product Data			X													

SUBMITTAL LIST

**ACTION SUBMITTAL
REVIEW ESTIMATE**

Park Acronym/Project Management Information System (PMIS) Number: **ROMO 160755/199703/249028/318223**

(Complete this portion for Architect / Engineer (A/E) construction service task order negotiation.)

Project Title: **Replace Undersized Entrance Station at Fall River Entrance**

ARCHITECT / ENGINEER REVIEW TIME
(Indicate in whole or partial hours.)

SUBMITTAL			REQUIREMENTS (Indicate with X)										ARCHITECT / ENGINEER REVIEW TIME (Indicate in whole or partial hours.)								
SPECIFICATION SECTION	PARAGRAPH NUMBER	DESCRIPTION	INFORMATIONAL				ACTION						ARCHITECT	CIVIL ENGINEER	STRUCTURAL ENGINEER	MECHANICAL ENGINEER	ELECTRICAL ENGINEER	PROJECT MANAGER COORDINATION	LANDSCAPE ARCHITECT		
			CERTIFICATIONS OR LABORATORY TESTS	REPORTS OR CALCULATIONS OR PLAN	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	SAMPLES	SHOP DRAWINGS	MOCKUP	MANUFACTURER DATA AND INSTRUCTIONS	OTHER										
09 93 00	1.3B	Samples for Selection																			X
09 96 00	1.3C	Samples for Verification														X					
09 96 00	1.3D	Qualification Data for installer							X												
09 96 00	1.4	Mock Up						X													
09 96 00	1.6A	Product Data					X														
09 96 00	1.6B	Shop Drawings																			X
10 14 23.16	1.6C	Samples for Verification													X						
	1.6D	Product Schedule								X											
	1.4A	Maintenance Data.						X													
	1.3A	Product Data								X											
	1.3B	Shop Drawings				X															
10 26 00	1.3C	Samples for Initial Selection													X						
	1.4A	Warranty								X											
	1.5A	Maintenance Data.							X												
	1.3A	Product Data				X															
	1.4A	Maintenance Data.				X															
10 44 13	1.2A	Product Data													X						
	1.2B	Shop Drawings				X															
10 51 13	1.2C	Samples for Initial Selection													X						
	1.3A	Warranty								X											
	1.4A	Maintenance Data.							X												
	1.2A	Shop Drawings																			
	1.2B	Installation Instructions				X															
11 10 00	1.2D	Project List								X											
	1.2E	Test Reports													X						
	1.6	Warranty																			X
	1.3A	Product Data	X																		X
	1.3B	Shop Drawings				X															
12 24 13	1.3C	Samples													X						
	1.3D	Samples for Initial Selection								X											
	1.4A	Operations and Maintenance Data							X												
	1.5A	Product Data							X												
	1.5B	Shop Drawings				X															
12 32 16	1.5C	Samples for Initial Selection													X						
	1.5D	Samples for Verification								X											
	1.6	Warranty							X												
	1.7	Quality Standard Compliance Certificates							X												
	1.2A	Product Data				X															
	1.2B	Shop Drawings	X																		
12 36 61.19	1.2C	Samples for Initial Selection													X						
	1.3	Maintenance Data.								X											

SUBMITTAL LIST

**ACTION SUBMITTAL
REVIEW ESTIMATE**

Park Acronym/Project Management Information System (PMIS) Number: ROMO 160755/199703/249028/318223

(Complete this portion for Architect / Engineer (A/E) construction service task order negotiation.)

Project Title: Replace Undersized Entrance Station at Fall River Entrance

SUBMITTAL **REQUIREMENTS**
(Indicate with X)

ARCHITECT / ENGINEER REVIEW TIME
(Indicate in whole or partial hours.)

SPECIFICATION SECTION	PARAGRAPH NUMBER	DESCRIPTION	INFORMATIONAL					ACTION					ARCHITECT	CIVIL ENGINEER	STRUCTURAL ENGINEER	MECHANICAL ENGINEER	ELECTRICAL ENGINEER	PROJECT MANAGER COORDINATION	LANDSCAPE ARCHITECT
			CERTIFICATIONS OR LABORATORY TESTS	REPORTS OR CALCULATIONS OR PLAN	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	SAMPLES	SHOP DRAWINGS	MOCKUP	MANUFACTURER DATA AND INSTRUCTIONS	OTHER								
22 05 00	1.2	Product data for each type of product indicated			X														
	1.3	Product data for each type of product indicated																	
22 05 17	1.2	Product data										X							
	1.3	Field Quality-control test reports.			X														
22 05 18	1.4	Product Certification										X							
22 05 19	1.2	Product data for each type of product indicated										X							
	1.2	Product data for each type of product indicated	X																
22 05 23	1.2	Product data for each type of product indicated										X							
22 05 23.12	1.2	Product data for each type of product indicated										X							
22 05 23.14	1.2	Product data for each type of product indicated										X							
22 05 53	1.2	Samples										X							
22 07 19	1.2	Product data for each type of product indicated										X							
	1.3	System purging report						X											
22 11 16	1.3	Field Quality-control test reports.										X							
	1.2	Product data for each type of product indicated					X												
	1.3	Field Quality-control test reports.					X												
22 11 19	1.2	Product data for each type of product indicated																	
	1.3	Seismic Qualification					X												
22 13 16	1.3	Field quality-control test reports.																	
	1.4	Warranty					X												
	1.2	Product data for each type of product indicated					X												
	1.2	Shop Drawings						X											
22 13 19	1.3	Field Quality-control test reports.																	
	1.2	Product data for each type of product indicated																	
	1.5	Product data for each type of product indicated																	
23 05 23	1.5	Shop Drawings																	
23 05 29	1.5	Delegated Design																	
	1.6	Welding Certificates										X							
	1.5	Product data for each type of product indicated										X							
	1.5	Delegated Design	X																
23 05 48	1.6	Coordination Drawings																	
	1.6	Qualification Data for installer.																	
	1.6	Welding Certificates										X							
	1.6	Field Quality-control test reports.										X							
	1.6	Air-Mounting System Performance Certification	X			X													
	1.3	Strategies and Procedures Plan					X												
	1.3	Certified TAB Report	X																
23 05 93	1.2	Product data for each type of product indicated																	
	1.2	Shop Drawings																	
23 07 13	1.3	Field quality-control test reports.																	
	1.3	Product data for each type of product indicated																	
	1.3	Shop Drawings										X							
23 07 19	1.3	Samples																	

SUBMITTAL LIST

**ACTION SUBMITTAL
REVIEW ESTIMATE**

Park Acronym/Project Management Information System (PMIS) Number: ROMO 160755/199703/249028/318223

(Complete this portion for Architect / Engineer (A/E) construction service task order negotiation.)

Project Title: Replace Undersized Entrance Station at Fall River Entrance

ARCHITECT / ENGINEER REVIEW TIME
(Indicate in whole or partial hours.)

SUBMITTAL			REQUIREMENTS (Indicate with X)										ARCHITECT / ENGINEER REVIEW TIME (Indicate in whole or partial hours.)						
SPECIFICATION SECTION	PARAGRAPH NUMBER	DESCRIPTION	INFORMATIONAL				ACTION					ARCHITECT	CIVIL ENGINEER	STRUCTURAL ENGINEER	MECHANICAL ENGINEER	ELECTRICAL ENGINEER	PROJECT MANAGER COORDINATION	LANDSCAPE ARCHITECT	
			CERTIFICATIONS OR LABORATORY TESTS	REPORTS OR CALCULATIONS OR PLAN	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	SAMPLES	SHOP DRAWINGS	MOCKUP	MANUFACTURER DATA AND INSTRUCTIONS	OTHER								
	1.4	Qualification data for installer.																	
	1.4	Material Test Report						X		X									
	1.4	Field quality-control test reports.			X														
	1.2	Product data for each type of product indicated	X																
	1.3	Field quality-control test reports.		X															
23 23 00	1.3	Product data for each type of product indicated															X		
	1.3	Shop Drawings		X															
23 31 13	1.3	Delegated Design															X		
	1.4	Coordination Drawings								X									
	1.4	Welding Certifications								X									
	1.2	Product data for each type of product indicated		X															
	1.2	Shop Drawings	X																
23 31 16	1.3	Delegated Design															X		
	1.3	Coordination Drawings								X									
	1.3	Welding Certifications								X									
	1.3	Seismic Qualification Data		X															
	1.3	Field Quality-control test reports.	X																
	1.2	Product data for each type of product indicated			X														
	1.2	Product data for each type of product indicated		X															
23 33 00	1.2	Shop Drawings															X		
23 74 33	1.2	Product data for each type of product indicated															X		
										X									
23 81 26	1.3	Product data for each type of product indicated															X		
	1.3	Field quality-control test reports.																	
26 05 19	1.3	Product data for each type of product indicated															X		
	1.3	Field quality-control test reports.		X															
	1.4	Product data for each type of product indicated															X		
	1.4	Source quality-control test reports		X															
26 05 26	1.2	Product data for each type of product indicated															X		
	1.2	Field quality-control test reports.		X															
26 05 29	1.5	Product data for each type of product indicated															X		
	1.5	Shop Drawings								X							X		
	1.5	Welding Certificates	X																
26 05 33	1.3	Product data for each type of product indicated															X		
	1.3	Identification Schedule		X															
	1.4	Product data for each type of product indicated															X		
	1.4	Source quality-control test reports		X															
26 05 53	1.3	Product data for each type of product indicated															X		
	1.3	Identification Schedule		X															
	1.4	Construction Checklists															X		
	1.4	Product data for each type of product indicated		X															
26 05 73	1.3	Product data for each type of product indicated															X		
	1.3	Product Certificates	X																
	1.3	Qualification Data	X																

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			CERTIFICATIONS OR LABORATORY TESTS	REPORTS OR CALCULATIONS OR PLAN	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	SAMPLES	SHOP DRAWINGS	MOCKUP	MANUFACTURER DATA AND INSTRUCTIONS							
	1.3	Study Reports		X													
26 08 00	1.4	Shop Drawings		X													
26 09 23	1.4	Field quality-control test reports.		X													
	1.4	Product data for each type of product indicated							X				X				
	1.4	Shop Drawings		X					X								
26 24 16	1.4	Panelboard Schedules					X						X				
	1.4	Field quality-control test reports.		X					X								
	1.3	Product data for each type of product indicated					X										
	1.4	Shop Drawings							X								
	1.4	Product data for each type of product indicated		X									X				
26 27 13	1.3	Product data for each type of product indicated											X				
	1.4	Product data for each type of product indicated											X				
26 27 26	1.4	Shop Drawings											X				
	1.4	Product data for each type of product indicated											X				
26 28 16	1.4	Field quality-control test reports.		X									X				
	1.4	Product data for each type of product indicated							X				X				
	1.4	Shop Drawings		X					X								
26 41 13	1.4	Qualification data for installer.					X						X				
	1.4	Certification Letter	X						X								
	1.4	Field inspection reports		X			X										
	1.4	Shop Drawings							X								
	1.4	Product data for each type of product indicated	X										X				
	1.5	Field quality-control test reports.		X													
26 43 13	1.5	Sample Warranty											X				
	1.4	Product data for each type of product indicated		X									X				
	1.5	Field quality-control test reports.		X													
	1.4	Shop Drawings											X				
26 51 00	1.4	Qualification Data					X						X				
	1.4	Field quality-control test reports.		X					X								
	1.4	Warranties					X						X				
	1.3	Product data for each type of product indicated		X					X				X				
	1.4	Shop Drawings															
	1.4	Field quality-control test reports.											X				
27 05 26	1.3	Product data for each type of product indicated											X				
	1.4	Coordination Drawings		X													
27 05 28	1.4	Source quality-control test reports											X				
	1.2	Product data for each type of product indicated		X													
	1.3	Product data for each type of product indicated											X				
27 05 44	1.3	Shop Drawings											X				
27 11 00	1.4	Qualification Data											X				
	1.6	Qualification Data							X								
	1.4	Product data for each type of product indicated					X										
27 13 00	1.4	Product data for each type of product indicated					X										
28 05 00	1.4	Shop Drawings											X				

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28 16 00	1.4	Equipment and System Operation Description															
	1.4	Field quality-control test reports.							X								
	1.4	Warranties		X													
	1.4	Product data for each type of product indicated		X													
	1.4	Shop Drawings										X					
28 23 00	1.4	Equipment List										X					
	1.4	Manufacturer Seismic Qualification Data							X								
	1.4	Field quality-control test reports.		X									X				
	1.4	Warranties											X				
	1.4	Product data for each type of product indicated		X													
	1.4	Shop Drawings										X					
28 31 11	1.4	Delegated-Design Submittal										X					
	1.5	Qualification Data for installer.							X								
	1.6	Sample Warranty							X								
	1.7	Software and Firmware Operational Documentation					X										
												X					
	1.5	Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.			X												
	1.5	Record drawings, identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions. Information required may also be included in Division 1 Section "Project Record Documents."															
31 10 00	1.4	Material Test Reports					X										
31 10 00	1.5A	Sources		X													
31 20 00	1.5B	Delivery Tickets	X														
31 23 16							X										
31 23 16	1.4	Shop Drawings for Information: For dewatering system, show arrangement, locations, and details of wells and well points, locations of headers and discharge lines, and means of discharge and disposal of water.							X								
	1.4	Qualification data for installer.															
	1.5A	Sources			X												
	1.5B	Delivery Tickets					X										
31 23 91	1.4	Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.							X								
31 23 91	1.4	Record drawings at project closeout identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions performed during dewatering.						X									
31 23 91	1.4	Field Test Reports: Before starting excavation, submit test results and computations demonstrating that dewatering system is capable of meeting performance requirements.						X									
31 23 91	1.4	Copy of Permit from governing jurisdiction/agency.		X													
31 23 91	1.4	Product Data: For the following: each type of plastic warning tape.		X													
31 23 91	1.4	Samples: Contractor to submit representative samples of all materials proposed for use in bedding and trench backfilling operations to the Materials Testing and Inspections Agency for analysis and determination of compliance with the requirements specified herein.					X										

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(Complete this portion for Architect / Engineer (A/E) construction service task order negotiation.)

Project Title: Replace Undersized Entrance Station at Fall River Entrance

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31 23 33	1.4	Material Test Reports: Provided by Contractor from a qualified, independent materials testing and inspections agency indicating and interpreting test results for compliance of the following with requirements indicated: 1.Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill. 2.Laboratory compaction curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill.															
31 23 33	1.4	Permits: Submit a copy of the Construction Dewatering Permit from the Colorado Department of Public Health and Environment, Water Quality Control Division.						X									
31 23 33	1.4	CLSM: The Contractor shall submit a mix design and test data for approval, prior to excavating the area for which CLSMs are proposed for use. All materials of this category placed without previous approval, or which do not perform as specified, will be rejected by the Government and all costs incurred for removal and replacement of these materials will be at the Contractor's expense.	X														
31 23 33	1.4	The Contractor shall cooperate with the Engineer in obtaining and providing samples of all specified materials.				X											
31 23 33	1.4	The Contractor shall submit certified laboratory test certificates for all items required in this section.												X			
31 37 00	1.5	Product Data: For each type of product indicated, include technical data and tested physical and performance properties.						X									
31 37 00	1.5	Job-Mix Designs: For each job mix proposed for the work. Job mix shall be tested and produced within 12 months of scheduled paving operations.	X														
32 12 16	1.5	Material Test Reports: For each paving material. Test reports shall be current to within 12 months of scheduled paving operations.												X			
32 12 16	1.5	Material Certificates: For each paving material, signed by providers.												X			
32 12 16	1.5	Product Data: For each type of manufactured material and product indicated.	X														
32 12 16	1.5	Design Mixes: For each concrete pavement mix, and includes alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Mix shall be tested and produced within 12 months of scheduled paving operations.	X														
32 13 13	1.5	Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials. Test reports shall be current to within 12 months of scheduled paving operations. 1.Aggregates. 2.Cement. 3.Admixtures.												X			

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32 13 13	1.5	Material Certificates: Signed by manufacturers certifying that each of the following materials used in the project complies with requirements: 1.Cementitious materials and aggregates. 2.Steel reinforcement and reinforcement accessories. 3.Fiber reinforcement. 4.Admixtures. 5.Curing compounds. 6.Applied finish materials. 7.Bonding agent or adhesive. 8.Joint fillers.															
32 13 13	1.5	Field quality-control test reports.	X														
32 13 13	1.5	Pavement Joint Layout Plan: Plan to show joint locations and typical dimensions for review and approval by the Contracting Officer. Joint layout plans shall be submitted for review and approval a minimum two (2) weeks prior to construction.	X														
32 13 13	1.5	Traffic Control Plan: Submitted to the Contracting Officer for review and approval a minimum two (2) weeks prior to implementation.	X														
32 13 13	1.4	Product Data: For each joint-sealant product indicated.		X													
32 13 13	1.4	Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.		X													
32 13 73	1.4	Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following: 1.Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants. 2.Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.															
32 13 73	1.4	Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.	X														
32 13 73	1.4	Warranty: As required by Division 1 – Warranty Section: Contractor agrees to repair or replace joint sealers (including labor, materials, and any necessary associated costs) which fail to perform as watertight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance or general durability; or appear to deteriorate in any other manner not clearly specified by submitted manufacturer’s data as an inherent quality of material for exposure indicated. Provide warranty signed by Installer and Contractor.	X														
32 13 73	1.2A	Sample	X														
32 13 73	1.3A	Source					X										
32 14 00	1.3B	Mock Up						X									
32 14 00	1.3A	Material Analysis			X												
32 14 00	1.3B	Sample														X	
32 15 40	1.3A	Material Analysis	X														
32 15 40	1.3B	Samples						X									
32 15 40	1.4	Product Data: Submit manufacturer’s published descriptive literature and complete specifications for products specified herein.															
32 15 40	1.4	Material Certificates		X				X									

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(Complete this portion for Architect / Engineer (A/E) construction service task order negotiation.)

Project Title: **Replace Undersized Entrance Station at Fall River Entrance**

ARCHITECT / ENGINEER REVIEW TIME
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32 17 23	1.4	Material Test Reports															
32 91 19	1.2B	Samples	X														
32 91 19	1.2C	Product Data	X														
32 33 00	1.2B	Samples						X									
32 33 00	1.2C&D	Product Data: For drainage conduit, drainage panels, and geotextile fabrics. 1.Perforated pipe. 2.Solid pipe. 3.Geotextile fabrics.			X			X									
32 33 00	1.3A	Product Data: For drainage conduit, drainage panels, and geotextile fabrics. 1.Perforated pipe. 2.Solid pipe. 3.Geotextile fabrics.											X				
32 33 00	1.4A	Product Data						X									
32 91 13	1.3A	Product Data			X								X				
32 91 13	1.3B	Samples						X									
32 91 13	1.4A	Delivery Tickets					X										
32 91 13	1.4B	Soil Testing	X														
32 91 13	1.4	Contractor shall submit shop drawings, product data, and/or manufacturer's literature showing CIPP construction materials (including fabric tube and resin), installation and curing method, installed characteristics, and certifications that product conforms with these specifications. Contractor shall indicate where submittals do not conform to these specifications.												X			
32 92 19	1.3A	Product Data			X												
32 92 19	1.4	Contractor is responsible for obtaining all applicable City, County, and State permits for the project. Submit copies of all permits issued for project.												X			
33 01 30	1.4	Compatibility and Adhesion Test Reports: From sealant manufacturer.								X				X			
33 01 30	1.4	Product Data: For the following: 1.Piping specialties. 2.Fittings. 3.Valves, valve boxes and accessories. 4.Water meters and accessories. 5.Protective enclosures. 6.Fire hydrants. 7.Insulation material.					X										
33 01 30	1.4	Field Quality-Control Test Reports: From Contractor.	X														
33 11 00	1.4	Test Reports: Submit two (2) copies of laboratory gradation tests for bedding and trench stabilization materials, concrete mix design, asphalt mix designs, and compression test.												X			
33 11 00	1.4	Locates: Contractor must submit two (2) copies of utility locate drawings/receipts prior to beginning construction.	X														
33 11 00	1.4	As-Builts: Provide Engineer with copies of redlined, as-built plans upon completion of construction. Horizontal and vertical information is to be certified by a Colorado Licensed Professional Land Surveyor.												X			

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Project Title: **Replace Undersized Entrance Station at Fall River Entrance**

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33 11 00	1.4	Submit shop drawings or product data showing specific dimensions and construction materials for pipe, fittings, and manholes or certifications that products conform with specifications.		X															
33 11 00	1.4	Test Reports: Submit all field quality control test reports.		X															
33 31 00	1.3	Product Data: Pump curves, equipment schedules and data, material descriptions, construction details, dimensions of individual components and profiles.							X			X							
33 31 00	1.3	Shop Drawings: Show location and details of operational hardware and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, elevations, sections and other required installation and operational clearances, and details of anchorage and attachment and bracing.	X																
33 34 00	1.3	Wiring Diagrams: Power and control wiring. Differentiate between Manufacturer-installed and field-installed wiring and between components provided by Manufacturer and those provided by others.										X							
33 34 00	1.3	Product Certificates: Signed by Manufacturers certifying that products furnished comply with requirements.							X										
33 34 00	1.3	Quality Certifications: Submit ISO 9001, UL or similar certifications, that may be held by the Manufacturer.		X															
33 34 00	1.3	Qualification Data: Manufacturers/Suppliers shall provide a list of ten (10) similar projects completed in the U.S. within the past 5 years. Provided project information shall include project names and addresses, names, addresses and telephone numbers of owners, and other pertinent information such as design flow and influent and effluent parameters.	X																
33 34 00	1.3	Factory Testing: Equipment factory test results shall be submitted to the Contracting Officer.	X																
33 34 00	1.3	Field Test and Startup Reports: Field testing and startup monitoring reports shall be submitted to the Contracting Officer. Indicate and interpret test results for compliance with performance requirements.					X												
33 34 00	1.6	Product Data: For each type of product indicated. 1.Piping, gaskets, and related appurtenances 2.Flared end section shop drawings. 3.Cleanouts, inlets and area drains.	X																
33 34 00	1.6	Field Quality-Control Test Reports: Indicate and interpret test results for compliance with performance requirements.		X															
33 41 00	1.4	Product Data: For drainage conduit, drainage panels, and geotextile fabrics. 1.Perforated pipe. 2.Solid pipe. 3.Geotextile fabrics.							X			X							
33 41 00	1.2	Contractor is required to submit a traffic control plan to the Contracting Officer 14 days in advance of construction and will be responsible for ensuring that all relevant codes and regulations are followed.	X																
33 46 00	1.4	Submit product data on pumps, control equipment, control panels, valves, piping, electrical components, and all accessories to verify compliance with specifications.										X							

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34 01 00	1.4	Submittals shall include manufacturer's literature and installation recommendations, at a minimum. Submittals for the following pieces of equipment shall also include: 1.Chemical Feed Pump a.Manufacturer name b.Materials of construction c.Flow rate output control d.Maximum working pressure e.Maximum suction lift f.Motor type and voltage requirements 2.Diaphragm-Type Pressure Tank a.Manufacturer name b.Dimensional drawings including minimum clearances c.Tank volume d.Diameter of inlet/outlet e.Materials of construction f.NSF 61 certification for all wetted parts g.Recommended spare parts list h.Installation assembly/disassembly and repair instructions i.Protective coating system		X													
46 07 13	1.4	Product Certificates and Warranties: For each type of pump, tank, and other treatment equipment, signed by the product manufacturer.							X								
46 07 13	1.4	Operation and maintenance manuals: Provide five complete sets of loose-leaf operating and maintenance manuals. These manuals shall not only include descriptive material, but also drawings and figures bound in appropriate places. The manuals shall include operating and maintenance literature for all components provided in this section. The submitted literature shall be in sufficient detail to facilitate the operation, removal, installation, adjustment, calibration, and maintenance of each component provided under this section. 1.Chemical Disinfection Dosing System 2.Diaphragm-type pressure tank 3.Control systems 4.Valving and Appurtenances							X								
46 07 13			X			X											
46 07 13					X												

SECTION 01 35 13 – ARCHEOLOGICAL AND HISTORICAL RESOURCE PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. The work of Section 01 35 13 “Archeological and Historical Resource Protection” consists of protecting archeological and historical resources, and within and/or around the limits of disturbance limits.
- B. The area of work has the potential to contain prehistoric and historically significant buried features and artifacts. The Contractor shall strictly limit and control the depth and extent of excavations and disturbance, minimizing them to the greatest extent possible in order to avoid impacts within the project work area.
- C. The limits of disturbance for the work shown on the drawings has been submitted to and accepted by authorities with responsibility for ensuring that the scope of work is in compliance with cultural resource requirements. Any significant changes to the location of work, must be approved by the Contracting Officer and may require temporarily relocating work until the revised location is approved by required officials, as specified below.
- D. The government shall provide an archeological monitor to observe all excavation work in areas requiring monitoring. Requirements for coordination with the archeological monitor are specified in this Section.
 - 1. Archaeological Resources Protection Act (ARPA) and Section 106 Compliance shall be provided by the park.
 - 2. Areas Requiring Archeological Monitoring are identified in Appendix D of this specification.
- E. The Contractor shall provide maximum protection of government-provided data and information about prehistoric, historic resources, and other sensitive areas within the park. Upon the completion of the project, such data and information will either be (1) returned to the government or (2) destroyed in an appropriate manner approved by the Contracting Officer.

1.2 DEFINITIONS

- A. Archeological Resources: Archeological resources are the physical evidences of past human activity, including evidences of the effects of that activity on the environment. Archeological resources represent both prehistoric and historic time periods. They are found above and below ground and under water.
- B. Archeologically Sensitive Areas: Areas that have the potential to contain significant (National Register eligible) archeological resources. If National Register eligible or listed archeological resources could not be avoided, an appropriate mitigation strategy would be developed in consultation with the State Historic Preservation Officer (SHPO) and, if necessary, associated Native American tribes.

- C. Archeological Monitor: Representative of Government designated to oversee construction activities that could disturb archeological resources.
- D. Cultural Resource Specialist: A person employed by the park that meets the Secretary of the Interior's Professional Qualification Standards.
- E. Archaeological Resources Protection Act (ARPA) of 1979 (P.L. 96-95; 93 Stat. 712): defines archeological resources as any material remains of past human life or activities that are of archeological interest and at least 100 years old; Section 4 of the statute describes the requirements that must be met before Federal authorities can issue a permit to excavate or remove any archeological resource on Federal or Indian lands; the curatorial requirements of artifacts, and other materials excavated or removed.
- F. Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 (P.L. 101-601; 25 U.S.C. 3001-3013): defines the rights of Native American lineal descendants, Indian tribes, and Native Hawaiian organizations with respect to the treatment, repatriation, and disposition of Native American human remains and associated cultural items.
- G. Secretary of the Interior's Standards for the Treatment of Historic Properties: common sense historic preservation principles in non-technical language. They promote historic preservation best practices and can be found at <https://www.nps.gov/tps/standards.htm>

1.3 SUBMITTALS

- A. Daily Work Schedule: Detail construction work in archeologically sensitive areas. Submit to Contracting Officer (CO) 30 days before start of ground disturbing site work.

1.4 QUALITY ASSURANCE

- A. As specified in Section 01 11 00 "Summary of Work," orientation session for construction workers and job superintendent will be coordinated by the Contracting Officer and shall be attended by construction workers and job superintendent prior to the start of work. Orientation session will be repeated for changes of key personnel.
- B. Weekly progress meetings, as specified in Section 01 31 00 "Project Management and Coordination" shall include Archeological, and Historical Resource Protection as an agenda item to address:
 - 1. Identification of significant features within the work area and a protection plan for features that will be:
 - a. Protected and avoided.
 - b. Protected with minimal impacts (features that will have minimal destruction, damage, or alteration and features that will be temporarily removed, stored, and reinstalled).
 - c. Removed and replaced with materials, design, and workmanship in-kind following the Secretary of the Interior's Standards for the Treatment of Historic Properties.

PART 2 - PRODUCTS

2.1 DAILY WORK SCHEDULE

- A. A Daily Work Schedule is required for all work occurring within archeologically sensitive areas. Including;
 - 1. Starting and ending dates of ground-disturbing construction.
 - 2. Locations of temporary facilities, such as barriers, field offices, staging areas, sanitary facilities, borrow pits, and haul and access roads.
 - 3. Types of construction, such as clearing, topsoil stripping, structure or trench excavation, landscaping, and post construction clean-up.
 - 4. Methods and equipment used for each type of construction.
 - 5. Plan for relocating work in the event of temporary work stoppages at each archeologically sensitive area.

PART 3 - EXECUTION

3.1 BARRICADES

- A. Comply with requirements specified in Section 01 50 00 "Temporary Facilities and Controls."

3.2 SITE FEATURES

- A. Historical Resources: Carefully remove, store, and reinstall site features such as stone curbing, retaining walls, piles, bollards, picnic tables, and signs, etc. Site features shall be reinstalled in their original location and orientation. Consult Contracting Officer regarding any existing site features not called out on the demo site plan that require removal for work to progress.

3.3 OBSERVATION

- A. Archeological Monitor will observe all ground-disturbing site work, including construction of temporary facilities, at all archeologically sensitive areas, from a safe location mutually agreed on by Contractor and Monitor. As new ground is broken, Monitor will examine excavated materials, using construction layout centerline and perimeter staking as a reference point to record locations of findings.

3.4 DISCOVERY OF RESOURCES

- A. Archeological Findings
 - 1. Petroglyphs, artifacts, burial grounds or remains, structural features, ceremonial, domestic, and archeological objects of any nature, historic or prehistoric, found within the construction area, are the property of and will be removed only by the Government. Should Contractor's operations uncover or his employees find any archeological remains, Contractor shall suspend operations at the site of discovery; notify Contracting Officer

immediately of the findings; and continue operations in other areas. Included with the notification shall be a brief statement of the location and details of the findings. Should the temporary suspension of work at the site result in delays, or the discovery site require archeological studies resulting in delays or additional work for Contractor, the Contractor will be compensated by an equitable adjustment under the General Provisions of the Contract.

2. The Archeological Monitor will identify and document the discovered resource and an appropriate mitigation strategy will be developed if necessary. If necessary, the NPS Cultural Resource Specialist will consult with the State Historic Preservation Officer (SHPO) in accordance with 36 CFR Part 800.13, Post-review Discoveries. Depending on what is discovered, the NPS Cultural Resource Specialist may also consult with the tribes associated with the area.

B. Human Remains

1. If human remains are discovered, the contractor will cease all work, secure the area, and immediately notify the CO of the discovery. The NPS Cultural Resource Specialist will follow procedures outlined in the Native American Graves Protection and Repatriation Act (NAGPRA) to protect the site.

C. Confidentiality:

1. All archeological discoveries are confidential and information about those discoveries will remain confidential to the extent that they meet the definitions set forth at Section 304 of the National Historic Preservation Act, Section 9 of the Archeological Resources Protection Act, Native American Graves Protection and Repatriation Act, and similar legislation.

D. Additional Findings

1. In addition to archeological findings uncovered by Contractor's operations, if an Archeological Monitor, NPS Cultural Resource Specialist, Contracting Officer, or Inspector discover archeological resources in the area of work, suspend operations at the site of discovery as specified above. Delays; mitigation, if necessary; and further compliance consultation will be handled as specified above.

END OF SECTION 01 35 13 – ARCHEOLOGICAL AND HISTORICAL RESOURCE PROTECTION

SECTION 01 35 23 - SAFETY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 35 23 "Safety Requirements" includes establishing an effective accident prevention program and providing a safe environment for all personnel and visitors.

1.2 CONDITIONS PRESENT FOR PROJECT

- A. The existing site related potential safety concerns include but are not limited to: sudden weather changes, wildfire, flooding, animal encounters.
 - 1. Wildfire issues may result in local fire restrictions.
 - 2. Wildlife interactions shall be minimized for everyone's safety.
 - a. No feeding the wildlife.
 - b. Food storage regulations shall be followed.
 - c. Bear, mountain lion, and any unusual sightings shall be reported to the Contracting Officer.
 - 3. The contractor is recommended to include these subjects in the weekly safety meeting on an ongoing basis.

1.3 SUBMITTALS

- A. Accident Prevention Plan/Safety Plan: After contract award and before the Pre-Construction conference, submit for review, an Accident Prevention Plan/Safety Plan. The Contracting Officer will review the proposed Plan. If the plan requires any revisions or corrections, the Contractor shall resubmit the Plan within 10 days. No progress payments will be made until the Plan is accepted.

1.4 QUALITY ASSURANCE

- A. Comply with contract clauses entitled "Accident Prevention" and "Permits and Responsibilities". In case of conflicts between Federal, State, and local safety and health requirements, the most stringent shall apply. Equipment or tools not meeting OSHA requirements will not be allowed on the project sites. Failure to comply with the requirements of this section and related sections may result in suspension of work.
- B. Site Safety Supervisor:
 - 1. Designate authorized onsite representative for preparation and maintenance of the APP.
 - 2. Shall be responsible for:
 - a. Implementation and enforcement of the APP
 - b. Daily safety inspections
 - c. Conducting and documenting weekly and monthly safety meetings

- d. Review of safety requirements at progress meetings
- e. Compilation and maintenance of Safety Data Sheets (SDS) and safety reference materials
- f. Tracking and resolution of safety violations
- g. Site personnel and visitor compliance with site safety and health requirements and APP
- h. Investigation and reporting of accidents and injuries

C. Qualifications of Employees:

- 1. Physically and able to perform their assigned duties in a safe manner.
- 2. Do not allow employees whose ability or alertness is impaired because of prescription or illegal drug use, fatigue, illness, intoxication, or other conditions that may expose themselves or others to injury to perform work.
- 3. Provide operating instructions for equipment. Operators of vehicles, hoisting equipment, and hazardous plant equipment shall be able to understand signs, signals, operating instructions, and be fully capable of operating such equipment. Retain copies of operator licenses and certifications onsite.

1.5 ACCIDENT REPORTING

- A. Reportable Accidents: A project reportable accident is defined as medical attention beyond first aid, death, occupational disease, traumatic injury to employees or the public, fires, and property damage by accident in excess of \$100. Notify Contracting Officer immediately in the event of a reportable accident. Within 7 days of a reportable accident, fill out and forward to Contracting Officer an Accident/Property Damage Report (Form CM-22). Form may be obtained from the Contracting Officer.
 - 1. Follow OSHA guidelines for recordkeeping and reporting of reportable accidents sustained by employees of the Contractor and Sub-Contractors.
- B. All Other Accidents: The Contractor shall report all other accidents to the Contracting Officer as soon as possible and assist the Contracting Officer and other officials as required in the investigation of the accident.

1.6 RESOURCES

- A. COVID-19 (Coronavirus Disease 2019) information provided below is not intended to provide a complete analysis of requirements for Contractor and is provided as a courtesy.
 - 1. [Coronavirus.gov - www.coronavirus.gov](http://www.coronavirus.gov)
 - 2. Occupational Safety and Health Administration (United States Department of Labor) - [COVID-19 - https://www.osha.gov/SLTC/covid-19/](https://www.osha.gov/SLTC/covid-19/)
 - 3. Center for Disease Control (CDC)
 - a. [Get the Facts About Coronavirus - https://www.cdc.gov/coronavirus/2019-ncov/index.html](https://www.cdc.gov/coronavirus/2019-ncov/index.html)
 - b. [What Construction Workers Need to Know about COVID-19 - https://www.cdc.gov/coronavirus/2019-ncov/community/organizations/construction-workers.html](https://www.cdc.gov/coronavirus/2019-ncov/community/organizations/construction-workers.html)
 - 4. Federal Emergency Management Agency (FEMA) - [Coronavirus \(COVID-19\) Response - https://www.fema.gov/coronavirus](https://www.fema.gov/coronavirus)

5. National Park Service (NPS) - [NPS Public Health Update](https://www.nps.gov/aboutus/news/public-health-update.htm) - <https://www.nps.gov/aboutus/news/public-health-update.htm>

PART 2 - PRODUCTS

2.1 ACCIDENT PREVENTION PLAN/SAFETY PLAN

- A. The Plan shall be written to comply with OSHA and project requirements (a generic plan is not acceptable) including but not limited to the following:
 1. Name and qualifications of responsible supervisor to carry out the program.
 2. Weekly and monthly safety meetings.
 3. First aid procedures.
 4. Outline of each phase of the work, the hazards associated with each major phase, and the methods proposed to provide for property protection and safety of the public, National Park Service personnel, and Contractor's employees. Identify the work included under each phase.
 5. Training, both initial and continuing.
 6. Planning for possible emergency situations, such as floods, fires, cave-ins, slides, explosions, power outages, and wind storms. Such planning shall take into consideration the nature of construction, site conditions, and degree of exposure of persons and property (Emergency Action Plan).
 7. Fire Protection.
 8. Fall Protection Plan.
 9. Hazardous Communications Plan.
 10. Drivers Safety.
 11. Infectious Disease Preparedness:
 - a. Contractors are responsible for their employees' safety and the safety of job site visitors during the performance of this contract. We encourage Contractors to follow guidance from the Department of Labor (DOL), Occupational Safety and Health Administration (OSHA), the Centers for Disease Control and Prevention (CDC), and all other applicable local, city, and state mandates. We encourage Contractors to develop policies for infection prevention and an Infectious Disease Preparedness and Response Plan.
 - b. To the extent appropriate, Contractors should include the protective health and safety measures they intend to implement in any accident prevention or safety submittals required under this contract. These plans should contain preventive measures the Contractor intends to follow while performing work on government property as well as responsive and corrective actions to be taken if an employee exhibits symptoms or tests positive for contagion.
 - c. Upon contract award, Contractors should communicate with Contracting Officer regarding Contractor decisions and actions to protect the health and safety of workers for the duration of contract performance under which pandemic conditions exist.

2.2 FIRST AID FACILITIES

- A. Provide adequate facilities for the number of employees and the hazards associated with the types of ongoing construction work at the site.

2.3 PERSONNEL PROTECTIVE EQUIPMENT (PPE)

- A. Selection shall conform to OSHA Subpart E.

PART 3 - EXECUTION

3.1 DAILY SAFETY INSPECTIONS

- A. Conduct daily safety inspections and maintain daily safety reports which include:
 1. Area/operation inspected
 2. Date of inspection
 3. Identified hazards
 4. Corrective actions taken

3.2 EMERGENCY INSTRUCTIONS

- A. Post telephone numbers and reporting instructions for ambulance, physician, hospital, fire department, and police in conspicuous locations at the work site.

3.3 FIRE AND LIFE SAFETY

- A. Comply with the requirements of NFPA 241 (Standard for Safeguarding Construction, Alteration, and Demolition Operations).
- B. Store hazardous materials in accordance with manufacturer's and OSHA recommendations. Maintain readily available, on site, MSDS for each chemical.
 1. Immediately report all spills of hazardous materials to the park.
 2. Maintain a spill emergency response kit.

3.4 PROTECTIVE EQUIPMENT

- A. Inspect personal protective equipment daily and maintain in a serviceable condition. Clean, sanitize, and repair personal items, as appropriate, before issuing them to another individual.
- B. Inspect and maintain other protective equipment and devices before use and on a periodic basis to ensure safe operation.

3.5 SAFETY MEETINGS

- A. As a minimum, conduct weekly 15-minute "toolbox" safety meetings. These meetings shall be conducted by a foreman or supervisor and attended by all construction personnel at the worksite.
- B. Conduct monthly safety meetings for all levels of supervision. Meetings shall be attended by all contractors and subcontractors performing work on the site. Notify the Contracting Officer of meeting dates and times. These meetings shall be used to review the effectiveness of the Contractor's safety effort, to resolve current health and safety problems, to provide a forum for planning safe construction activities, and for updating the Accident Prevention Plan/Safety Plan. The Contracting Officer will attend the meeting and enter the results of the meetings into the daily log.

3.6 HARD HATS AND PROTECTIVE EQUIPMENT AREAS

- A. A hard hat area shall be designated by the Contractor. The hard hat area shall be posted by the Contractor in a manner satisfactory to the Contracting Officer.
- B. It is the Contractor's responsibility to require all those working on or visiting the site to wear hard hats and other necessary personal protective equipment at all times. As a minimum, provide two hard hats for use by visitors. Change liners before reissuing hats.

3.7 TRAINING

- A. First Aid: Provide adequate training to an adequate number of personnel to ensure prompt and efficient first aid.
- B. Hazardous Material: Train and instruct each employee exposed to hazardous material in safe and approved methods of handling and storage. Hazardous materials are defined as explosive, flammable, poisonous, corrosive, oxidizing, irritating, or otherwise harmful substances that could cause death or injury.

END OF SECTION 01 35 23 - SAFETY REQUIREMENTS

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SECTION 01 35 91 - HISTORIC PRESERVATION TREATMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 35 91 "Historic Preservation Treatment Procedures" includes special procedures for historic treatment on the Project including, but not limited to, the following:
 - 1. Storage and protection of existing historic stone.
 - 2. Temporary protection of historic stone during construction.
 - 3. Protection during application of chemicals.
 - 4. Protection during use of heat-generating equipment.
 - 5. Historic preservation treatment procedures.
- B. Areas of the project requiring historic preservation treatment:
 - 1. Repair of CCC era curb at pull out west of entrance station.
 - 2. Reconstruct two (2) historic stone headwalls of culvert near Big Horn Ranger Station.
 - 3. Salvage and resetting of stone steps near Big Horn Ranger Station. (Only if utility work requires impacting these.)
 - 4. Protection and rehabilitation of historic trail between the Fall River Road and Onsite Wastewater Treatment System.
- C. Related Sections:
 - 1. Section 01 35 13 "Archeological and Historical Resource Protection."
 - 2. Section 01 32 33 "Photographic Documentation."
 - 3. Section 04 01 40.91 "Stone Restoration"
 - 4. Section 04 34 00 "Stone Masonry."

1.2 DEFINITIONS

- A. "Preservation": To apply measures necessary to sustain the existing form, integrity, and materials of a historic property. Work may include preliminary measures to protect and stabilize the property.
- B. "Rehabilitation": To make possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features that convey its historical, cultural, or architectural values.
- C. "Restoration": To accurately return the form, features, and character of a property to its appearance at a particular period of time by means of the removal of features from other periods in its history and the repair and reconstruction of missing and deteriorated features from the restoration period.
- D. "Reconstruction": To reproduce in the exact form and detail a building, structure, or artifact as it appeared at a specific period in time. Reconstructed elements do not possess historic integrity in their own right since it is not original fabric.

- E. "Stabilize": To apply measures designed to reestablish a weather-resistant enclosure and the structural reinforcement of an item or portion of the building while maintaining the essential form as it exists at present. This level of intervention is aimed at retarding or arresting adverse impacts to structures.
- F. "Protect and Maintain": To remove deteriorating corrosion, reapply protective coatings, and install protective measures such as temporary guards; to provide the least degree of intervention.
- G. "Repair": To stabilize, consolidate, or conserve; to retain existing materials and features while employing as little new material as possible. Repair includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials. Within restoration, repair also includes limited replacement in kind, rehabilitation, and reconstruction, with compatible substitute materials for deteriorated or missing parts of features when there are surviving prototypes.
- H. "Replace": To duplicate in its entirety a historic element or feature by matching its historic pattern, detail and appearance. . Replacement is justified when original or historic elements are damaged beyond repair or are missing. Replacement methods includes the following conditions:
 1. Replacement with Original or Historic Fabric: Includes fabric salvaged from other locations or projects having identical architectural qualities. It means duplication of appearance using identical material possessing historical significance.
 2. Replacement with New Materials: Includes replacement with new material of like kind (custom fabricated or manufactured) that is currently in production. It means duplication of appearance using like material.
 3. Replacement with Substitute Materials: Includes replacement with a compatible substitute that is frequently contemporary and unlike the historic fabric. It means duplication of appearance using modern (non-traditional) material Use of substitute materials is not approved unless matching materials are not available.
- I. "Remove": To demolish or detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- J. "Remove and Salvage": To detach items from existing construction and deliver them to the NPS.
- K. "Remove and Reinstall": To detach items from existing construction, repair and prepare them for reuse, and reinstall them where indicated.
- L. "Existing to Remain" or "Retain": Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled.
- M. "Material in Kind": Material that closely matches existing materials, through comparison of architectural qualities and salient characteristic such as species, cut, color, grain, , dimension, profile, thickness, and finish.

1.3 ACTION SUBMITTALS

- A. Historic Preservation Treatment Program:

1. Submit a written plan for each phase or process including protection of surrounding materials during operations.
 2. Describe in detail materials, methods, and equipment to be used for each phase of work, including proposed method of identifying and tracking original location for proper reinstallation.
 3. Include Treatment Plan for each area of historic preservation work:
 - a. Salvage and reinstallation of historic stone for Bighorn Ranger Station culvert headwalls.
 - b. Salvage and reinstallation of stone steps near Bighorn Ranger Station.
 - c. Uncovering and repair of historic stone curb at pullout.
 - d. Bid Option 7: Salvage and resetting the historic stone curb at pullout
 - e. Protection of historic trail between Fall River Road and Onsite Wastewater Treatment System (OWTS) during demolition/construction.
 - f. Rehabilitation of historic trail after replacement of the OWTS.
 4. If the contractor's proposed method of work affects other areas of historic sensitivity, the Contracting Officer shall add areas of historic preservation needing a specific treatment plan for approval.
 5. To be approved by compliance through the Contracting Officer.
- B. Alternative Methods and Materials: If alternative methods and materials to those indicated are proposed for any phase of work, provide a written description including evidence of successful use on other, comparable projects, and program of testing to demonstrate effectiveness for use on this Project.
1. To be approved by the Contracting Officer.
- C. Product Data:
1. Cutsheet or other statement (such as a PDF/printout of Amazon product page) of product to be used on project
 2. To be approved by compliance through the Contracting Officer.
- D. Restoration Specialist Qualifications:
1. Documentation of the firm's experience in the field of historic stone masonry. 10 years experience minimum.
 2. Five examples of comparable stone restoration projects and reference contact for each.
 3. Resume and documentation of experience for the onsite supervisor.
 4. To be approved by compliance through the Contracting Officer.
- E. Photographs or Videotape:
1. Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by historic treatment operations as per Section 04 01 40.91 "Stone Restoration" and Section 04 34 00 "Stone Masonry."
 2. Submit before work begins.
 3. Photos and video shall be in accordance with Section 01 32 33 "Photographic Documentation."

1.4 QUALITY ASSURANCE

- A. Historic Preservation Treatment Specialist Qualifications: A firm that employs personnel, including supervisory personnel, experienced and skilled in the processes and operations indicated. 10 years experience minimum.
- B. Restoration Specialist: Work shall be performed by a firm having not less than ten years successful experience in comparable stone restoration projects and employing personnel skilled in stone restoration processes and operations indicated.
 - 1. Firm shall identify and provide the applicable experience for the onsite supervisor for all historic preservation related work.
- C. Contractor must be fully conversant with Secretary of the Interior's "Standards for the Rehabilitation of Historic Buildings" and attendant preservation briefs associated with stone restoration and repair.

1.5 STORAGE AND PROTECTION OF HISTORIC MATERIALS

- A. Salvaged and Reinstalled Historic Stone:
 - 1. Repair historic stones to functional condition adequate for intended reuse.
 - 2. Protect items from damage during transport and storage.
 - 3. Stones shall be stored and transported on labelled pallets.
 - 4. Stones shall be secured to pallet through banding and wrapping.
 - 5. Transport items to storage area approved by Contracting Officer.
 - 6. Reinstall stones per Section 04 34 00 "Stone Masonry."
 - 7. Do not dispose of items removed from existing construction without prior written consent of Contracting Officer.
- B. Existing Historic Stone to Remain: Protect construction indicated to remain against damage and soiling during historic treatment.
- C. Storage and Protection: The historic stone must be stored adjacent to the features being restored, it should not be leaving the immediate vicinity due to risk of loss or damage to the lichen. Secure stored stone to protect from theft.
 - 1. Propose staging location and method for Contracting Officer review prior to the start of work on historic stone.
 - 2. Identify removed items with an inconspicuous mark indicating their original location.
 - 3. Develop a key plan to track individual stone location for removal and reinstallation.
 - 4. Protect existing lichen on stones from damage during storage.
 - a. Store stones with lichen up.

1.6 PROJECT-SITE CONDITIONS

- A. Exterior Repair Work:
 - 1. Proceed with the work only when forecasted weather conditions are favorable.

- a. Wet Weather: Do not attempt repairs during rainy or foggy weather, when the relative humidity is above 80 percent.
 - b. Do not perform exterior wet work when the air temperature is below 40 deg F (5 deg C).
 - c. Do not begin patching, repairing, setting, or repointing when there is any likelihood of frost or freezing.
2. Perform repair work only during daylight hours.

PART 2 - PRODUCTS

2.1 Equipment requiring approval prior to use:

- A. Marking Implement:
 1. Permanent Marker
 2. Waterproof
 3. UV Resistant
 4. Enamel Paint
 5. Non-toxic per ASTM 4236
 - a. No butyl acetate or 1,2,4-trimethylbenzene
 6. Basis of Design: Competitive Advantage Enamel Paint Marker MPD-X
 - a. Or equal

PART 3 - EXECUTION

3.1 PROTECTION, GENERAL

- A. Comply with manufacturer's written instructions for precautions and effects of products and procedures on adjacent building materials, components, and vegetation.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Temporary Protection of Historic Stone during Construction:
 1. Protect existing stone during installation of temporary protections and construction. Do not deface or remove existing stone.
 2. Attachments of temporary protection to existing construction is prohibited.
- D. Protect landscape work adjacent to or within work areas as follows:
 1. Provide barriers to protect tree trunks.
 2. Bind spreading shrubs.
 3. Use coverings that allow plants to breathe and remove coverings at the end of each day. Do not cover plant material with a waterproof membrane for more than 8 hours at a time.
 4. Set scaffolding and ladder legs away from plants.

- E. Existing Culvert: Prior to the start of work, clear out culvert to ensure that catching and/or retrieving small stones and piece of mortar is thorough. Notify Contracting Officer immediately of conditions that do not permit safe and complete salvage of historic materials.
 - 1. Provide method to prevent stone or mortar residue from being swept out of area of work.
 - 2. Protect waterway from pollutants. Catch or filter out sediments, allowing only clean water to pass.

3.2 PROTECTION DURING CLEANING

- A. No use of chemical cleaners is currently anticipated. Cleaning of new mortar from stones during reinstallation/reconstruction shall be accomplished mechanically unless approved by Contracting Officer.
- B. Provide a method to prevent stone or mortar residue from polluting the waterway. Catch or filter out sediments, allowing only clean water to pass.
- C. Comply with requirements in Division 01 Section 01 50 00 "Temporary Facilities and Controls."
- D. In the event that chemical cleaners are deemed necessary and are approved by the Contracting Officer:
 - 1. Cover adjacent surfaces with materials that are proven to resist chemical cleaners selected for Project unless chemicals being used will not damage adjacent surfaces. Use covering materials that contain only waterproof, UV-resistant adhesives. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
 - 2. Do not clean surfaces during winds of sufficient force to spread cleaning solutions to unprotected surfaces.
 - 3. Neutralize and collect alkaline and acid wastes and dispose of outside park boundaries.
 - 4. Dispose of runoff from chemical operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

3.3 REHABILITATION OF HISTORIC TRAIL

The trail that passes between Fall River Road and the site of the Onsite Wastewater Treatment System (OWTS) replacement is historic and therefore shall be protected outside of the limits of disturbance and rehabilitated within those limits.

- A. As an area of historic resources, work done in this area shall be monitored by NPS provided archeological monitor. See Appendix D for plan of areas requiring archeological monitoring. Coordinate with the Contracting Officer the plan for work in this area and the timing of the monitoring.
- B. Contractor shall photograph the area prior to commencement of demolition/construction according to Section 01 32 33 "Photographic Documentation."

1. Approval of photographs by Contracting Officer required before commencement of demolition/construction.
- C. Portions of the trail that are outside the limits of disturbance shall be protected from construction impact.
1. If trail is damaged by construction activities, contractor shall rehabilitate the trail to the original state.
- D. All rehabilitation work performed on the trail and adjacent disturbed areas shall reference Appendix F: Class III Cultural Resource Inventory for rehabilitation work in accordance with Secretary of Interior Standards.

3.4 HISTORIC PRESERVATION TREATMENT PROCEDURES

The principal aim of preservation work is to halt the process of deterioration and stabilize the item's condition, to sustain the integrity of the historic element, feature or structure being preserved. Cyclic maintenance is often required as well as repair work. Repair is required where specifically indicated. The following procedures shall be followed:

1. Retain as much existing material as possible; repair and consolidate rather than replace.
 2. Use additional material or structure to reinforce, strengthen, prop, tie, and support existing material or structure.
 3. Use reversible processes wherever possible.
 4. Use traditional replacement materials and techniques if possible. New work shall be distinguishable from old work and original materials, craftsmanship, and techniques.
 5. Record the existing condition before commencing with repair work; document with preconstruction photos, sketches and field notes. Record repair work during construction with periodic construction photos and daily inspection reporting. Photo documentation is specified in Division 01 Section 01 32 33 "Photo Documentation for Historic Preservation Projects".
- B. Prohibit smoking by personnel performing work on or near historic structures.
- C. Notify Contracting Officer of visible changes in the integrity of material or components whether due to environmental causes including biological attack, UV degradation, freezing, or thawing; or due to structural defects including cracks, movement, or distortion.
1. Do not proceed with the work in question until directed by Contracting Officer.
- D. Where Work requires existing features to be salvaged:
1. Perform these operations without damage to the material itself, to adjacent materials, or to the substrate.
 2. Protect existing lichen from damage during removal.
 3. During the salvage process, each stone shall be labeled with a number and cardinal direction and the numerical location documented on a photograph or drawing.
 4. Labelling shall be done only in the submitted and approved marker.
 5. Rocks shall be stored on pallets and each pallet shall be labelled, with contents keyed to the numerical identifiers and the photograph/drawing.

- E. Identify new or replacement stone and features with inconspicuous, permanent marks to distinguish them from original stone. Record the legend of identification marks and the locations of these marks on Record Drawings.
- F. When cleaning off excess new mortar, match samples of existing stone that have been cleaned and identified for acceptable cleaning levels. Avoid over-cleaning to prevent damage to existing stone and lichen during cleaning. Only the gentlest methods available should be attempted. Hand cleaning mechanical methods only.

END OF SECTION 01 35 91 - HISTORIC PRESERVATION TREATMENT PROCEDURES

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 40 00 "Quality Requirements" includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements. The quality of all work shall be the responsibility of the Contractor.
 - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and control procedures that facilitate compliance with the Contract Document requirements.
- C. See Divisions 02 through 49 Sections for specific test and inspection requirements.

1.2 DEFINITIONS

- A. Quality Assurance Services: Activities, actions, and procedures performed before and during execution of the work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality Control Services: Tests, inspections, procedures, and related actions during and after execution of the work to evaluate that actual products incorporated into the work and completed construction comply with requirements.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Mockups for this project shall not be part of the final work product unless previously approved by the Contracting Officer.
- D. Preconstruction Testing: Tests and inspections that are performed specifically for the project before products and materials are incorporated into the work to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by a Nationally Recognized Testing Laboratory (NRTL), a National Voluntary Laboratory Accreditation Program (NVLAP), or a testing agency qualified to conduct product testing, to establish product performance and compliance with industry standards.

- F. Source Quality Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- G. Field Quality Control Testing: Tests and inspections that are performed on-site for installation of the work and for completed work.
- H. Testing Agency or Laboratory: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Using a term such as “carpentry” does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as “carpenter.” It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.

1.3 CONFLICTING REQUIREMENTS

- A. Reference Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Contracting Officer for a decision before proceeding.
- B. Minimum Quality Levels: The quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Contracting Officer for a decision before proceeding.

1.4 SUBMITTALS

- A. Quality Control Plan:
 - 1. After contract award and before the Pre-Construction conference, submit for approval a written Contractor Quality Control (CQC) plan.
 - 2. If the plan requires any revisions or corrections, the Contractor shall resubmit the plan within 10 days.
 - 3. The Government reserves the right to require changes in the plan during the contract period as necessary to obtain the quality specified.
 - 4. No change in the approved plan may be made without written concurrence by the Contracting Officer.
- B. Qualification Data: For testing agencies specified in “Quality Assurance” Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

- C. Contractor's Quality Control Daily Reports: Submit showing all inspections and tests on the first workday following the date covered by the report. Quality Control Supervisor shall utilize the forms attached at the end of this Section or Contractor supplied forms with the same information.
- D. Test Reports
 - 1. Test reports shall be completed by the person performing the test.
 - 2. Use the Daily Test Report Information Sheet form attached at the end of this Section or Contractor supplied form with the same information.
 - 3. Submit Daily Test Information Sheets with Quality Control Daily Reports.
 - 4. Submit failing test results and proposed remedial actions within four hours of noted deficiency.
 - 5. Submit three copies of complete test results no later than one calendar day after the test was performed.
- E. Accessibility Inspection Report:
 - 1. Fill out the applicable sections of the Accessibility Inspection Report and attach to the Quality Control Daily Report.
 - 2. Utilize the attached Accessibility Inspection form to document compliance with the Architectural Barriers Act Accessibility Standards (ABAAS).
 - 3. Inspect at various stages of construction as needed to insure the finished product meets the standards.
 - 4. Submit report not later than one calendar day after the inspection was performed.
- F. Off-Site Inspection Reports: Submit prior to shipment.
- G. If the CQC plan and Quality Control Daily Reports are not submitted as specified, the Contracting Officer may retain all payments until such time a plan is accepted and implemented, or may retain payments for work completed on days there are no Quality Control Daily Reports.
- H. Permits, Licenses, and Certificates: For NPS records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the work.
- I. For Special Tests and Inspections: See APPENDIX G: Statement of Structural Tests and Special Inspections, JVA, Inc., dated December 22, 2021

1.5 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Contractors Quality Control Staff:
 - 1. The Contractor's Quality Control Supervisor shall be assigned no other duties.
 - 2. The Contractor's designated Quality Control Supervisor shall be on the project site whenever contract work is in progress.

3. The Contractor's job supervisory staff may be used to assist the Quality Control Supervisor supplemented, as necessary, by additional certified testing technicians.
- C. **Installer Qualifications:** A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
 - D. **Manufacturer Qualifications:** A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
 - E. **Fabricator Qualifications:** A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
 - F. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.
 - G. **Specialists:** Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 1. Requirement for specialists shall not supersede building codes and regulations governing the work.
 - H. **Testing Agency Qualifications:** An independent agency with the experience, qualifications and capability to conduct testing and inspecting indicated; and with additional qualifications specified in individual Sections; and where required by Contract, is acceptable to the Contracting Officer.
 1. All measuring devices, laboratory equipment, and instruments shall be calibrated at established intervals against certified standards. Upon request, measuring and testing devices shall be made available for use by the Government for verification tests.
 - I. **Factory-Authorized Service Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
 - J. **Mockups:** Before installing portions of the work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed work:
 1. Build mockups in location and of size indicated or, if not indicated, as directed by Contracting Officer.
 2. Notify Contracting Officer fourteen (14) days in advance of dates and times when mockups will be constructed.
 3. Demonstrate the proposed range of aesthetic effects and workmanship.

4. Obtain Contracting Officer's approval of mockups before starting work, fabrication, or construction.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
6. Demolish and remove mockups when directed, unless otherwise indicated.
7. Anticipated mockups include but are not limited to: boardformed concrete, stone veneer, integrally colored concrete flatwork (all colors), thermoplastic striping or inlaid striping (depending on the bid option selected), a retaining wall section, and the stone installation in the median. See specifications Div 2-49 for all mockup requirements and specific conditions.

1.6 QUALITY CONTROL

- A. The Contractor is responsible for all testing and inspections. Inspect and test work as needed to ensure that the quality of materials, workmanship, construction, finish, and functional performance are in compliance with applicable specifications, drawings, and those required by the Building Code.
 1. Engage a qualified testing agency to perform these quality-control services.
 2. Submit the appropriate report, for each quality-control service.
 3. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 4. The Contracting Officer may designate test locations.
- B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
- C. Re-testing/Re-inspecting: Provide quality-control services for re-testing and re-inspecting for construction that replaced work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with NPS and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 1. Notify Contracting Officer and Contractor promptly of irregularities or deficiencies observed in the work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit 3 copies of the certified written report of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the work.
- E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- F. Coordination: Coordinate sequence of activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS

2.1 QUALITY CONTROL PLAN

- A. The Quality Control Plan shall include:
1. A list of personnel responsible for quality control and assigned duties. Include each person's qualifications.
 2. A copy of a letter of direction to the Contractor's Quality Control Supervisor outlining assigned duties.
 3. Names, qualifications, and descriptions of laboratories to perform sampling and testing, and samples of proposed report forms.
 4. Methods of performing, documenting, and enforcing quality control of all work.
 5. Methods of monitoring and controlling environmental pollution and contamination as required by regulations and laws.

PART 3 - EXECUTION

3.1 OFF-SITE CONTROL

- A. Items that are fabricated or assembled off-site shall be inspected for quality control at the place of fabrication.

3.2 ON-SITE CONTROL

- A. Notification:
1. Notify the Contracting Officer at least 48 hours in advance of the preparatory phase meeting.

2. Notify the Contracting Officer at least 24 hours in advance of the initial and follow-up phases.
- B. Preparatory Phase: Perform before beginning each feature of work.
1. Review control submittal requirements with personnel directly responsible for quality assurance and quantity control of the work. As a minimum, the Contractor's Quality Control Supervisor and the foreman responsible for the feature of work shall be in attendance.
 2. Review all applicable specifications sections and drawings related to the feature of work.
 3. Ensure that copies of all referenced standards related to sampling, testing, and execution for the feature of work are available on site.
 4. Ensure that provisions have been made for field control testing.
 5. Examine the work area to ensure that all preliminary work has been completed.
 6. Verify all field dimensions and advise the Contracting Officer of discrepancies with contract documents.
 7. Ensure that necessary equipment and materials are at the project site and that they comply with approved shop drawings and submittals.
 8. Document all preparatory phase activities and discussions on the Contractor's Quality Control Daily Report.
- C. Initial Phase:
1. As soon as work begins, inspect and test a representative portion of a particular feature of work for quality of workmanship.
 2. Review control testing procedures to ensure compliance with contract requirements.
 3. Document all initial phase activities and discussions on the Contractor's Quality Control Daily Report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
- D. Follow-Up Phase: Inspect and test as work progresses to ensure compliance with contract requirements until completion of work.
- E. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be required on the same feature of work for the following reasons:
1. Quality of on-going work is unacceptable.
 2. Changes occur in the applicable quality control staff, on-site production supervision, or work crew.
 3. Work on a particular feature of work is resumed after a substantial period of inactivity.

3.3 DOCUMENTATION

- A. Maintain Quality Control Daily Reports, Daily Test Report Information Sheets, and Accessibility Inspection Reports (attached) of quality control activities and tests.
- B. Quality Control Daily Reports may not be substituted for other written reports required under clauses of the contract, such as Disputes, Differing Site Conditions, or Changes.

3.4 ENFORCEMENT

- A. The Contractor shall stop work on any item or feature pending satisfactory correction of any deficiency noted by the quality control staff or the Contracting Officer.

3.5 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
 - 2. Comply with the Contract Document requirements for Division 01 Section 01 73 29 "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility.

END OF SECTION 01 40 00 - QUALITY REQUIREMENTS

CONTRACTOR'S QUALITY CONTROL DAILY REPORT

REPORT NO. _____ SHEET 1 OF _____

PROJECT		CONTRACT NO.		DATE	
PARK		CONTRACTOR'S REPRESENTATIVE ON THE JOB			
WEATHER (Rain, Snow, Cloudy, Windy, etc.)	RAINFALL Inches	TEMPERATURE MAX. MIN.		GROUND CONDITIONS (Dry, Damp, Wet, Frozen, etc.)	
1. PRIME CONTRACTOR					
NO. EMPLOYEES BY JOB CATEGORIES	Hours	HEAVY EQUIPMENT ON JOB	NO. UNITS	HRS. WORKING	
				YES	NO
WORK PERFORMED BY PRIME CONTRACTOR:					
MATERIALS DELIVERED			OFFICIAL VISITORS TO SITE		
2A. SUBCONTRACTOR, _____: (If more than one subcontractor use copies of following page.)					
NO. EMPLOYEES BY JOB CATEGORIES	Hours	HEAVY EQUIPMENT ON JOB	NO. UNITS	HRS. WORKING	
				YES	NO
WORK PERFORMED BY SUBCONTRACTOR:					
3. SPECIFIC INSPECTIONS: (Inspections performed, results, and corrective actions)					
4. TESTING: <input type="checkbox"/> Check if any testing was performed today. (Complete and attach Test Report Information Sheets.) Type and Location of Testing: _____					
5. VERBAL INSTRUCTION RECEIVED FROM GOVERNMENT ON CONSTRUCTION DEFICIENCIES OR RE-TESTING REQUIRED:					
6. REMARKS:					
7. CERTIFICATION:					
I certify that the above report is complete and correct and that I, or my authorized representative, have inspected all work performed this day by the prime contractor and each subcontractor and determined that all materials, equipment, and workmanship are in strict compliance with the plans and specifications except as may be noted above. _____					
Contractor's Quality Control Representative					

SUBCONTRACTOR WORK CONTINUED:

CONTRACT NO. _____

REPORT NO. _____
SHEET OF _____

2 SUBCONTRACTOR,						
NO. EMPLOYEES BY JOB CATEGORIES	Hours	HEAVY EQUIPMENT ON JOB	NO. UNITS	HRS. WORKING		
				YES	NO	Comments

WORK PERFORMED BY SUBCONTRACTOR:

2 SUBCONTRACTOR,						
NO. EMPLOYEES BY JOB CATEGORIES	Hours	HEAVY EQUIPMENT ON JOB	NO. UNITS	HRS. WORKING		
				YES	NO	Comments

WORK PERFORMED BY SUBCONTRACTOR:

2 SUBCONTRACTOR,						
NO. EMPLOYEES BY JOB CATEGORIES	Hours	HEAVY EQUIPMENT ON JOB	NO. UNITS	HRS. WORKING		
				YES	NO	Comments

WORK PERFORMED BY SUBCONTRACTOR:

2 SUBCONTRACTOR,						
NO. EMPLOYEES BY JOB CATEGORIES	Hours	HEAVY EQUIPMENT ON JOB	NO. UNITS	HRS. WORKING		
				YES	NO	COMMENTS

WORK PERFORMED BY SUBCONTRACTOR:

DAILY TEST REPORT INFORMATION SHEET

CONTRACT NO. _____ REPORT NO. _____

SHEET _____ OF _____

1. Individual Making Inspection or Test:	
2. Testing Laboratory; Name:	Phone #:
Address:	
3. Description of Work and Test Method: _____	
4. Location of Samples and Tests or Inspections: _____	
5. Specification Section:	
6. Inspection or Test Data: _____	
7. Test Results and Interpretations of Test Results: _____	
8. Comments or Professional Opinion About Compliance of Inspected Work or Tested Work with contract Document Requirements:	
9. Recommendations: _____	
10. Corrective Actions Taken: _____	

CERTIFICATION:

I certify that the above testing report is complete and correct and that all testing performed this day for this contract is in strict compliance with the plans and specifications except as noted above.

Signature of Inspector

CQC ACCESSIBILITY INSPECTION REPORT

Updated 5/18/11

CONTRACT NO. _____ REPORT NO. _____

Note: This report covers only the most common accessibility requirements. This form can be expanded as needed for elements not shown. Inspect for compliance with all requirements of the ABAAS. Use applicable sections for each inspection.

CQC Inspector: _____	Date: _____
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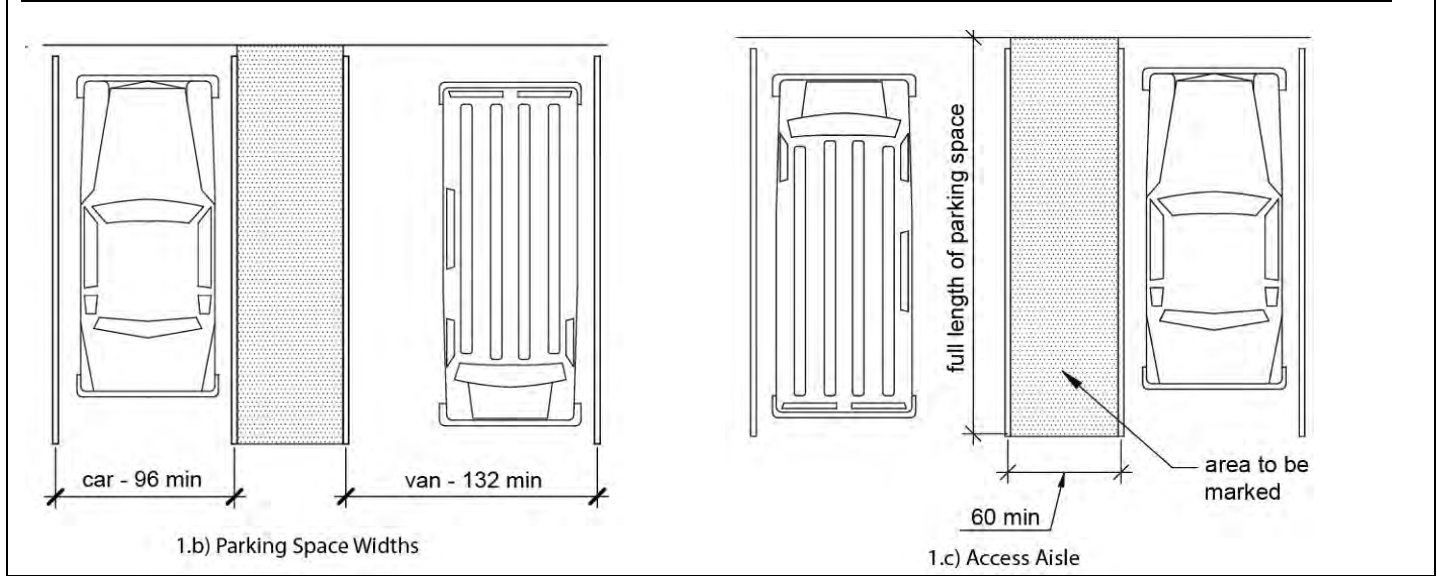
1. **Parking and Passenger Loading Zones:** Attach a copy of the grading plan with each accessible parking space running and cross slope readings noted. All slopes shall be measured with a 24" electronic level.

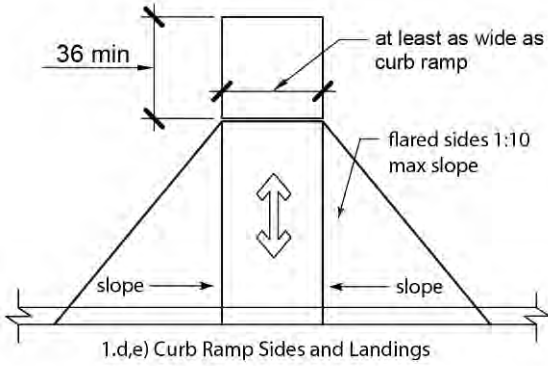
Location/Notes:

	Yes	No	N/A	
a)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Accessible spaces and access aisles running slope and cross slope is 1:48 (2%) or less. Measure at 3' intervals.
b)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Car spaces are at least 96 inches wide and van spaces 132 inches wide measured to striping centerline or face of curb.
c)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Access aisles are 60 inches wide min. measured to striping centerline and adjoin an accessible route.
d)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Curb ramp running slope is 1:12 (8.33%) or less, and cross slope is 1:48 (2%) or less. Measure at 3' intervals.
e)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Curb ramp has a 36 inch minimum landing length at top, running slope and cross slope is 1:48 (2%) or less
f)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Curb ramp flared side slopes are 1:10 (10%) or less.
g)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Passenger loading zone (drop-off area) running slope and cross slope is 1:48 (2%) or less. Area has flush curb.

Inspection Results: _____

Corrective Actions Needed/Taken: _____



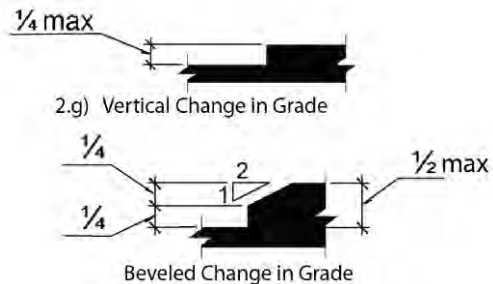
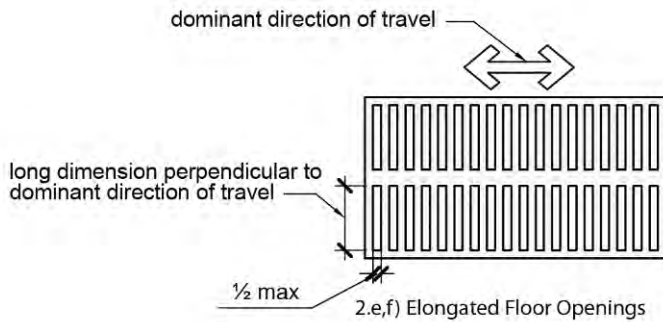


2. **Walking surfaces and Accessible Route:** The accessible route is defined as the pedestrian route from the accessible parking and passenger loading zones to all accessible facilities and features. Attach accessible route plan and/or grading plan with accessible route highlighted and running and cross slope readings noted. All slopes shall be measured with a 24" electronic level.

- | | Yes | No | N/A | |
|----|--------------------------|--------------------------|--------------------------|--|
| a) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Floor and ground surfaces are stable, firm, and slip resistant as defined by ADAABAAG Advisory 302.1 . |
| b) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Running slope of all walking surfaces on the accessible route is 1:20 (5%) or less. Measure at 3-foot intervals. |
| c) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Cross slope of walking surfaces is 1:48 (2%) or less. Measure at 3-foot intervals. |
| d) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Clear widths of walking surfaces are 36 inches minimum. |
| e) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Elongated openings in floor or ground surfaces are 1/2 inch wide or less. |
| f) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Elongated openings are perpendicular to direction of travel. |
| g) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Accessible route surface changes are 1/2 inch or less with 1/4 inch maximum vertical change. |
| h) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Floor drains and grates on accessible route meet all above requirements. |

Inspection Results: _____

Corrective Actions Needed/Taken: _____

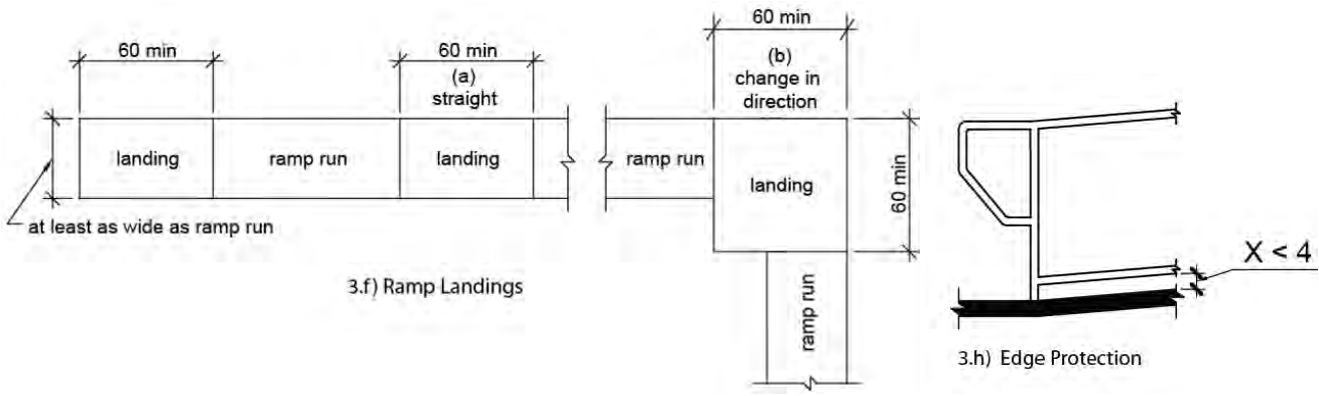


3. **Ramps:** Ramps are defined as walking surfaces on the accessible route that are steeper than 1:20 (5%) but less than 1:12 (8.33%). Attach grading plan with running and cross slope readings noted. All slopes shall be measured with a 24" electronic level.

- | | Yes | No | N/A | |
|----|--------------------------|--------------------------|--------------------------|---|
| a) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Running slope is 1:12 (8.33%) or less. Measured at 3-foot intervals. |
| b) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Cross slope is 1:48 (2%) or less. Measured at 3-foot intervals. |
| c) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Clear width is 36 inches minimum, clear width between handrails is 36 inches minimum. |
| d) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Rise for any ramp run is 30 inches maximum. |
| e) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Ramps have landings at the top and the bottom of each ramp run. |
| f) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Landing clear length is 60 inches minimum, running slope and cross slope of landing is 1:48 (2%) or less. |
| g) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Ramps with a rise greater than 6 inches have handrails. |
| h) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Ramps and landings have edge protection on both sides that prevents passage of a 4 inch diameter sphere. |

Inspection Results: _____

Corrective Actions Needed/Taken: _____

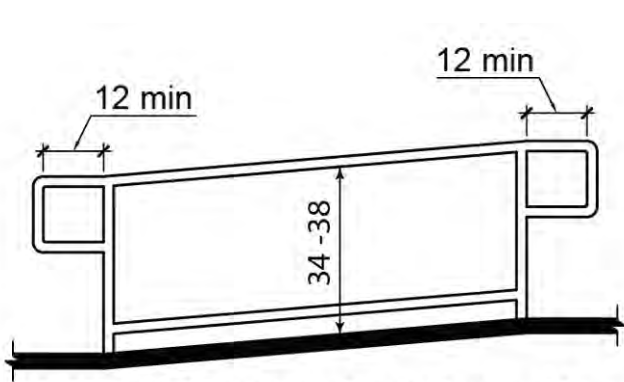


4. Handrails: Verify each handrail.

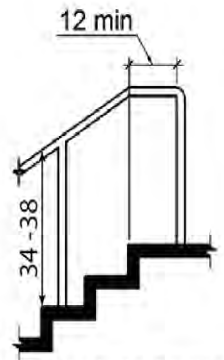
	Yes	No	N/A	
a)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Top of handrail is 34 inches minimum and 38 inches maximum vertically above walking surfaces.
b)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Handrails extend 12 inches minimum beyond the top and bottom of ramp runs.
c)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Free standing handrails have edge protection that prevents passage of a 4 inch diameter sphere.
d)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Handrails extend horizontally 12 inches minimum at top of stairs.
e)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Handrails extend at slope of the stair flight at bottom of stairs minimum one tread depth beyond last riser.
f)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Handrail clearance is 1 1/2 inches clear minimum to walls and above horizontal attachments.

Inspection Results: _____

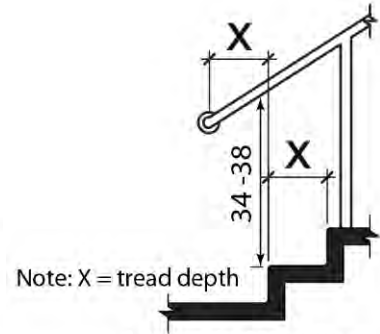
Corrective Actions Needed/Taken: _____



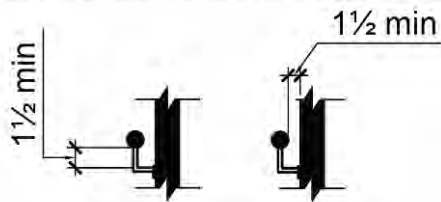
4.a,b) Handrail Extension at Top and Bottom of Ramp



4.c) Handrail Extension at Top of Stair



4.d) Handrail Extension at Bottom of Stair



4.e) Handrail Clearance

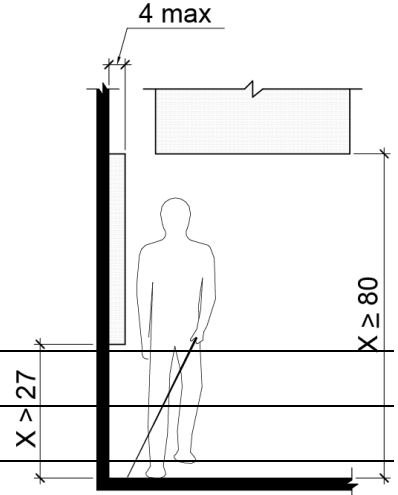
5. [Drinking fountains](#) (Two spout heights required for each drinking fountain).
Verify fountains do not create a [protruding object](#):

Location/Notes:

- | | <u>Yes</u> | <u>No</u> | <u>N/A</u> | |
|----|--------------------------|--------------------------|--------------------------|--|
| a) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Spout outlet is 36 inches maximum above the finish floor or ground for wheelchair accessible spout. |
| b) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Spout outlet for standing persons is 38 inches minimum and 43 inches maximum above the finish floor. |
| c) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Drinking fountain is recessed or has 27 inches maximum space from floor to bottom of fountain. |

Inspection Results: _____

Corrective Actions Needed/Taken: _____



5.c) Limits of Protruding Objects

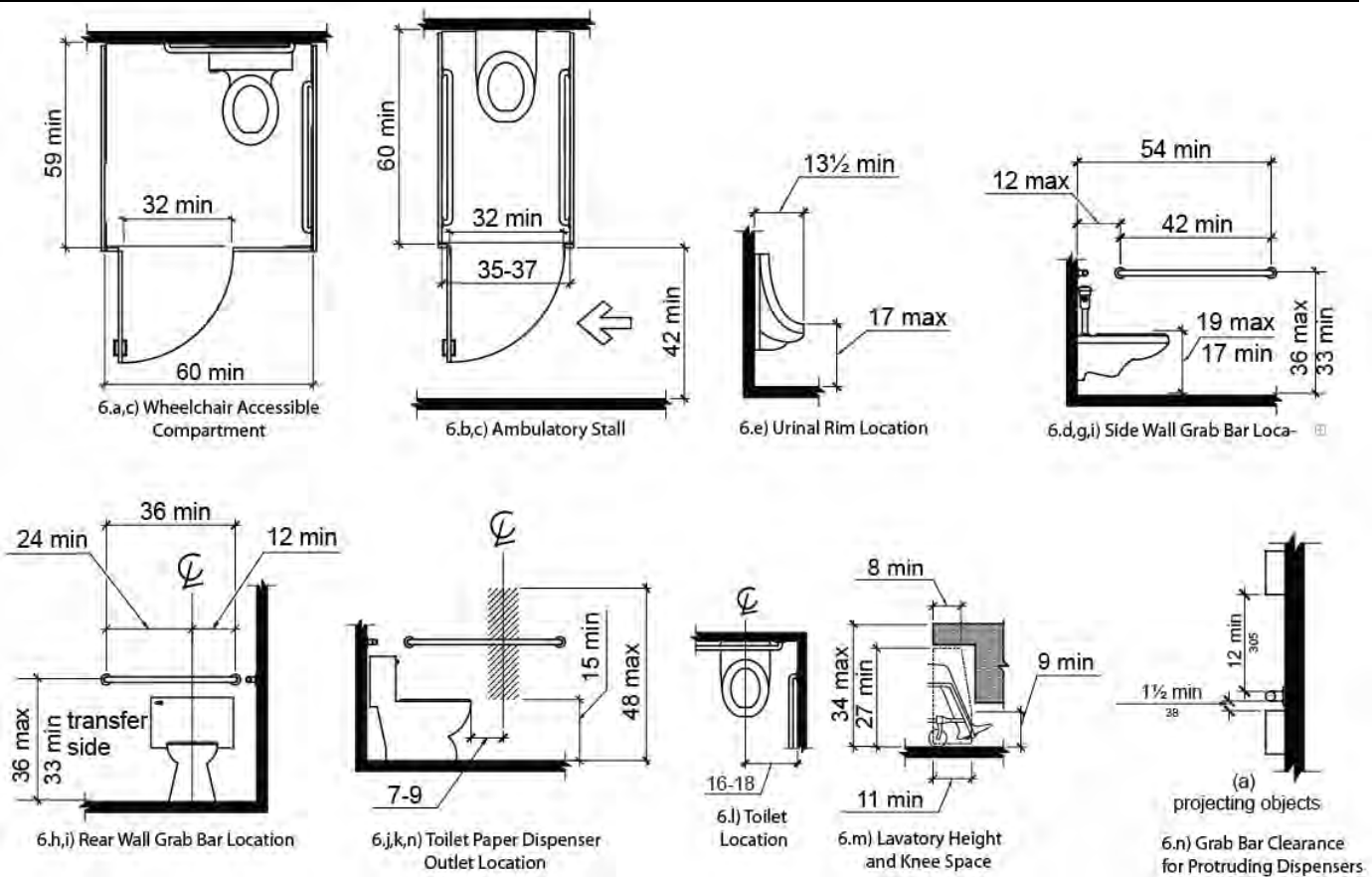
6. **Toilet Compartments:** Attach floor plan and elevations with as-constructed dimensions noted.

Location/Notes:

	Yes	No	N/A	
a)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Wheelchair accessible compartment is 60 inches wide min., and 59 inches deep minimum.
b)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Ambulatory stall is 60 inches deep min. width of 35 inches min. and 37 inches max, toilet is centered in stall.
c)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Accessible compartment has 32 inch wide door opening minimum with door opening outward, or adequate clear space for door opening inward.
d)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Seat height is 17 inches minimum and 19 inches maximum measured to the top of the seat.
e)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Urinal rim is 17 inches maximum above the finish floor and 13 1/2 inches deep minimum.
f)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Urinal has a clear floor space of 30 inches wide by 48 inches long minimum.
g)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Side wall grab bar is 42 inches long minimum, located 12 inches maximum from the rear wall.
h)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Rear wall grab bar is 36" long min. extends from toilet centerline 12" min. one side, 24" min. other side.
i)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Grab bar height is 33 inches minimum and 36 inches maximum.
j)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Toilet paper dispensers are 7 inches min. and 9 inches max. in front of the toilet to centerline of the dispenser.
k)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Toilet paper dispenser outlet is 15 inches minimum and 48 inches maximum above the finish floor.
l)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Centerline of the wheelchair stall toilet is 16 inches min. to 18 inches max. from the side wall.
m)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sinks and counters are 34" max. above floor with 27" min. knee space. Drain pipes are insulated or concealed.
n)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Space between grab bar and projecting objects below is 1 1/2 inches minimum; space above is 12 inches minimum.
o)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Wheelchair accessible compartment and Ambulatory stall have door pulls on both sides of the door near the latch.

Inspection Results: _____

Corrective Actions Needed/Taken: _____



7. **Service Counters, Dining and Work Surfaces:** (Service counters are parallel or forward approach)

Location/Notes:

Yes No N/A

- a) Parallel Approach. Counter is 36 inches long min. and 36 inches high max.
- b) Forward Approach. Counter surface is 30 inches long min. and 36 inches high max, knee space under counter.
- c) Tops of dining and work surfaces are 28 inches minimum and 34 inches maximum above the finish floor.

Inspection Results: _____

Corrective Actions Needed/Taken: _____

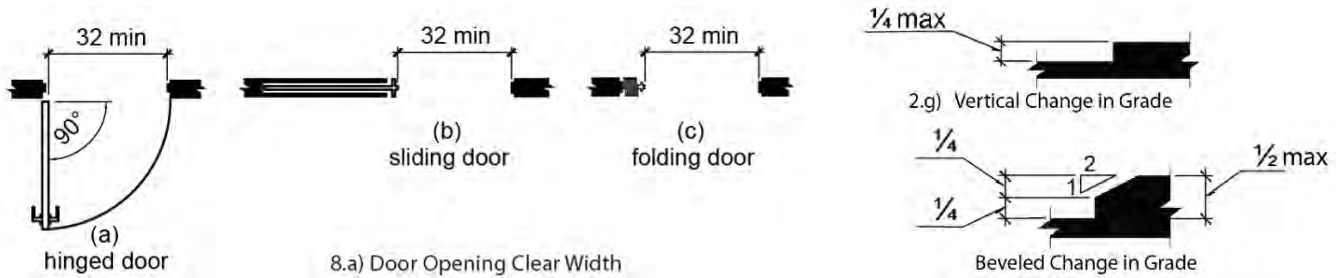
8. [Doors](#): Attach accessible route plan with accessible door dimensions and threshold heights.

Location/Notes:

- | | Yes | No | N/A | |
|----|--------------------------|--------------------------|--------------------------|--|
| a) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Door openings on accessible routes provide a clear width of 32 inches minimum. |
| b) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Door closers move door from open position of 90 degrees to 12 degrees from the latch is 5 seconds min. |
| c) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Spring hinge doors close from open position of 70 degrees to closed position in 1.5 seconds minimum. |
| d) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Fire doors have the minimum opening force allowable by the appropriate administrative authority. |
| e) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Interior hinged doors have an opening force of 5 pounds maximum. |
| f) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Thresholds at doors on accessible route are 1/2 inch or less with 1/4 inch maximum vertical change. |

Inspection Results: _____

Corrective Actions Needed/Taken: _____



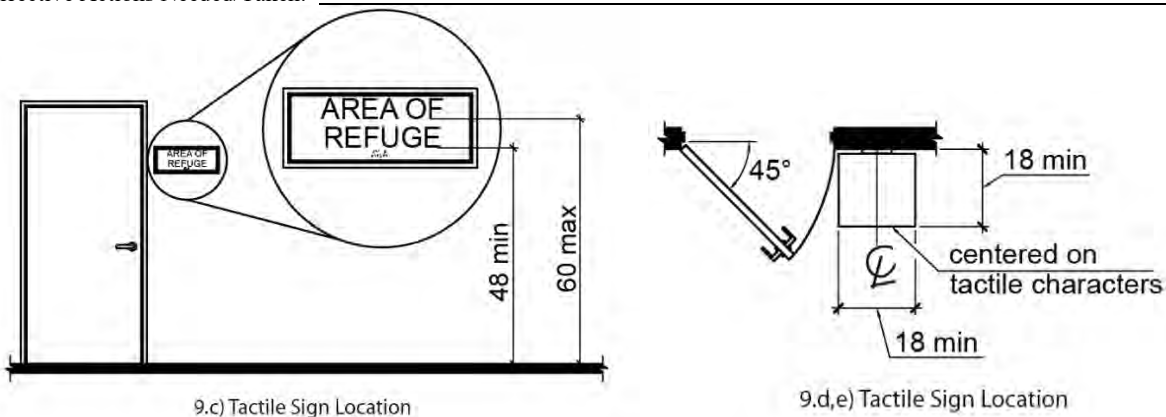
9. [Signs](#):

Location/Notes:

- | | Yes | No | N/A | |
|----|--------------------------|--------------------------|--------------------------|---|
| a) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Parking space signs are 60 inches minimum above finish ground surface measured to the bottom of the sign. |
| b) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Van parking space sign includes the designation "van accessible". |
| c) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Tactile characters on signs are 48 inches minimum and 60 inches maximum above the finish floor. |
| d) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Sign is located alongside the door at the latch side. |
| e) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Sign is located with a clear floor space of 18 inches by 18 inches minimum. |

Inspection Results: _____

Corrective Actions Needed/Taken: _____



CERTIFICATION:

I certify that the above inspection report is complete and correct and that this inspection is in compliance with the contract documents.

Signature of Inspector

SECTION 01 42 00 – REFERENCE STANDARDS

PART 1 - GENERAL

1.1 ENVIRONMENTAL DEFINITIONS

- A. Definitions pertaining to sustainable development: As defined in ASTM E2114 and as specified herein.
- B. Biobased Materials: As defined in the Farm Security and Rural Investment Act, for purposes of Federal procurement of biobased products, "biobased" means a "commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials." Biobased materials also include fuels, chemicals, building materials, or electric power or heat produced from biomass as defined by The Biomass Research and Development Act of 2000.
 - 1. Biobased content: Amount of biobased carbon in the material or product as a percentage of weight (mass) of total organic carbon in the material or product.
- C. Chain-of-Custody: Process whereby a product or material is maintained under physical possession or control during its entire life cycle.
- D. Deconstruction: Disassembly of buildings for purpose of recovering materials.
- E. Environmentally preferable products: Products and services that have a lesser or reduced effect on the environment in comparison to conventional products and services. Refer to EPA's Final Guidance on [Environmentally Preferable Purchasing Program](#).
- F. Non-Renewable Resource: A resource that exists in a fixed amount that cannot be replenished on a human time scale. Non-renewable resources have potential for renewal only by geological, physical, and chemical processes taking place over of millions of years. Examples include iron ore, coal, and oil.
- G. Recycled Content Materials: Products that contain pre-consumer or post-consumer materials as all or part of their feedstock. Recycled content claim shall be consistent Federal Trade Commission (FTC) Guide for Use of Environmental Marketing Claims.
- H. Renewable Resource: A resource that is grown, naturally replenished, or cleansed, at a rate which exceeds depletion of the usable supply of that resource. A renewable resource can be exhausted if improperly managed. However, a renewable resource can last indefinitely with proper stewardship. Examples include trees in forests, grasses in grasslands, and fertile soil.

1.2 QUALITY ASSURANCE

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied

directly into Contract Documents to the extent referenced. Such standards are made a part of Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of Contract Documents, unless otherwise indicated.
- C. Conflicting Requirements: Where compliance with two or more standards is specified, and standards may establish different or conflicting requirements for minimum quantities or quality levels, comply with most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Contracting Officer (CO) for decision before proceeding.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless Contract Documents include more stringent requirements, applicable construction industry standards have same force and effect as if bound or copied directly into Contract Documents to the extent referenced. Such standards are made a part of Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities found in Section 01 42 00 Sources for Reference Publications, [Unified Facilities Guide Specifications](#) (UFGS) (accessible via [Masters](#) website > Downloads section > click on UFGS Master (WBDG Website). Names, telephone numbers, and websites are subject to change and are believed to be accurate and up-to-date as of date of Contract Documents.

XX EXAMPLE Association (The)
www.EXAMPLE.org

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in following list. Names, telephone numbers, and websites are subject to change and are believed to be accurate and up-to-date as of date of Contract Documents.

ICC International Code Council (888) 422-7233
www.iccsafe.org

ICC-ES ICC Evaluation Service, Inc. (800) 423-6587
icc-es.org (562) 699-0543

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in following list. Names, and websites are subject to change and are believed to be accurate and up-to-date as of date of Contract Documents.

ABA & Architectural Barriers Act (ABA)
ABAAS United Architectural Barriers Act Accessibility Standards (ABAAS)
States Access www.access-board.gov
Board

CoE Army Corps of Engineers
www.usace.army.mil

EPA Environmental Protection Agency
www.epa.gov

FCC Federal Communications Commission
www.fcc.gov

GSA General Services Administration
www.gsa.gov

NCHRP National Cooperative Highway Research Program
(See TRB (Transportation Resource Board))

NIST National Institute of Standards and Technology
www.nist.gov

OSHA Occupational Safety & Health Administration
www.osha.gov

TRB Transportation Research Board
www.nationalacademies.org/trb/transportation-research-board

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in following list. Names, telephone numbers, and websites are subject to change and are believed to be accurate and up-to-date as of date of Contract Documents.

ABAAS Architectural Barriers Act Accessibility Standards
www.access-board.gov

CFR Code of Federal Regulations
Available from Government Printing Office
www.govinfo.gov/app/collection/cfr

FED-STD Federal Standard
(See FS (Federal Specification))

1.5 ENVIRONMENTAL REFERENCE STANDARDS

A. American Forest and Paper Association:

1. Sustainable Forestry Initiative

B. American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE):

- **ASHRAE 52.2**, *Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size*
- **ASHRAE 55**, *Thermal Environmental Conditions for Human Occupancy*
- **ASHRAE 62.1**, *Ventilation for Acceptable Indoor Air Quality*
- **ASHRAE/IESNA 90.1**, *Energy Standard for Buildings, Except Low-Rise Residential Buildings*

C. American Association of State Highway and Transportation Officials (AASHTO):

- M288 Geotextile Specification for Highway Applications

D. American Society for Testing and Materials International (ASTM):

- C128 Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
- C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- C1601 Standard Test Method for Field Determination of Water Penetration of Masonry Wall Surfaces
- C289 Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)
- C311 Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
- C33 Standard Specification for Concrete Aggregates
- C593 Standard Specification for Fly Ash and Other Pozzolans for Use With Lime
- C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
- C989 Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
- D198 Standard Test Methods of Static Tests of Lumber in Structural Sizes
- D3864 Standard Guide for Continual On-Line Monitoring Systems for Water Analysis
- D3960 Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
- D4017 Standard Test Method for Water in Paints and Paint Materials by Karl Fischer Method
- D4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
- D4444 Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters
- D4491 Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- D4552 Standard Practice for Classifying Hot-Mix Recycling Agents
- D4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- D4840 Standard Guide for Sampling Chain-of-Custody Procedures

- D4887 Standard Test Method for Preparation of Viscosity Blends for Hot Recycled Bituminous Materials
- D5268 Standard Specification for Topsoil Used for Landscaping Purposes
- D5663 Standard Guide for Validating Recycled Content in Packaging Paper and Paperboard
- D5759 Standard Guide for Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
- D5792 Standard Practice for Generation of Environmental Data Related to Waste Management Activities: Development of Data Quality Objectives
- D5834 Standard Guide for Source Reduction Reuse, Recycling, and Disposal of Solid and Corrugated Fiberboard (Cardboard)
- D5852 Standard Test Method for Erodibility Determination of Soil in the Field or in the Laboratory by the Jet Index Method
- D6155 Standard Specification for Nontraditional Coarse Aggregates for Bituminous Paving Mixtures
- D6245 Standard Guide for Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation
- D6270 Standard Practice for Use of Scrap Tires in Civil Engineering Applications
- D6629 Standard Guide for Selection of Methods for Estimating Soil Loss by Erosion
- D692 Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures
- D7186 Standard Practice for Quality Assurance Observation of Roof Construction and Repair
- E1105 Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference
- E1609 Standard Guide for Development and Implementation of a Pollution Prevention Program
- E1686 Standard Guide for Selection of Environmental Noise Measurements and Criteria
- E1780 Standard Guide for Measuring Outdoor Sound Received from a Nearby Fixed Source
- E1827 Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
- E1861 Standard Guide for Use of Coal Combustion By-Products in Structural Fills
- E2114 Standard Terminology for Sustainability Relative to the Performance of Buildings
- E2128 Standard Guide for Evaluating Water Leakage of Building Walls
- E2129 Standard Practice for Data Collection for Sustainability Assessment of Building Products
- E241 Standard Guide for Limiting Water-Induced Damage to Buildings
- E2432 Standard Guide for General Principles of Sustainability Relative to Buildings
- E413 Standard Classification for Rating Sound Insulation
- E779 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
- E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- F2034 Standard Specification for Sheet Linoleum Floor Covering
- F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

E. Center for Resource Solutions

- Green-e program

- F. Environmental Protection Agency (EPA):
 - Comprehensive Procurement Guidelines
 - ENERGY STAR
 - Environmentally Preferable Purchasing Program Final Guidance
 - Indoor Air Quality Building Education and Assessment Model (I-BEAM)
 - National Environmental Performance Track
 - Pollution Prevention (P2)

- G. Forest Stewardship Council:
 - Chain-Of-Custody
 - Forest Management

- H. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - IAQ Guidelines for Occupied Buildings Under Construction

- I. Southcoast Air Quality Management District:
 - 1168 Adhesive And Sealant Applications

- J. US Green Building Council:
 - LEED™ 2009 Green Building Rating System
 - LEED™ v4 (version 4) Green Building Rating System

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00 – REFERENCE STANDARDS

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 50 00 "Temporary Facilities and Controls" includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Shared Use of Entrance
 - 1. Visitor use of this park entrance shall continue through construction period. Contractor shall develop a traffic routing and phasing plan for maintaining vehicular access through the site at all times.
 - 2. Temporary closures of all lanes of traffic may be necessary for brief, intermittent periods. Night work may be considered to minimize disruption of access and placement of steel plates over work areas to facilitate access during non-work hours will be permitted contingent on Contracting Officer approval.
 - a. Temporary closures of longer than 10 minutes shall be coordinated in advance with park staff.
 - b. Temporary closures of 10-30 minutes shall be discussed in advance during weekly progress meetings.
 - c. Temporary closures of greater than 30 minutes shall be requested from the Contracting Officer 7 days (measured from receipt of request) prior to date and of closure and shall include method of operation for emergency vehicle access to and from east side of park during closure. This type of closure shall be approved in writing by the Contracting Officer prior to the contractor putting this type of closure in place.
 - 3. Emergency Vehicle Access is required. Contractor shall coordinate with dispatch to ensure access is provided at all times.

1.2 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum as required.
- B. Water Service: Water from existing water system owned and operated by NPS is available for use without metering and without payment of use charges.
 - 1. Water available at the site is limited by the size of the well to approximately 400 gal/day.
 - 2. For additional water, contractor may transport water from the park's east headquarters maintenance area. Access to water at the headquarters area shall be arranged in advance through the Contracting Officer.
- C. Electric Power Service: Electricity from existing onsite electrical utility is available for use without metering and without payment of use charges.

1.3 SUBMITTALS

- A. Construction Staging and Phasing Plan: The staging and phasing plans, or Maintenance of Traffic (MOT plans, provided in the contract documents are not intended to dictate or otherwise determine the Contractor's means, methods, or construction sequencing. The provided plans are for bidding purposes and have been developed as one potential strategy to construct the project while satisfying the requirements of this specification. At the Contractor's choosing, Contractor shall submit their own staging/phasing plan for review and approval by the Contracting Officer. Plan shall include:
1. Location of one (1) temporary kiosk with internet and power sufficient for register, fans, radio, point-of-sale, and light. The kiosk shall be a prefabricated booth or a purpose built structure contingent on Contracting Officer approval. See section below for specific requirements.
 2. One lane coming into the park at all times.
 3. One lane exiting the park at all times.
 4. Construction vehicle inspection area.
 5. Traffic Management Plan: identification of traffic control measures and safety devices, including cutsheets and/or equipment information for variable message signs. Plan shall include but are not limited to:
 - a. Type, number, and location of signs
 - b. Placement of flaggers
 - c. Placement of cones/fencing and barricades
 - d. Construction vehicle access points (accessing temporary roadway)
 - e. Pedestrian crossing points (construction staff only)
 6. Method of detouring vehicles away from the Fall River Entrance to the Beaver Meadows Entrance (both on and off Federal property).
 7. Method of Operation for transitioning from one phase configuration to the next.
 8. Method of Operation for instances when access – incoming or outgoing or both – must be interrupted. Plan shall include but are not limited to:
 - a. Duration of anticipated delays
 - b. Use of pilot cars (if applicable)
 - c. Notification procedures
 - d. Emergency vehicle access procedures
- B. Temporary Kiosk Shop Drawings: Contractor shall submit review and approval by the Contracting Officer. Plan shall include:
1. Product data (shop drawings, manufacturer's drawings, etc.) on prefabricated unit.
 2. Shop drawings for purpose built kiosk/booth if not prefabricated unit. Include plans – architectural, mechanical, and electrical/data – elevations, and section through transaction window.
 3. Product data for moveable transaction surface.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Environmental Protection: Provide environmental protection as required by authorities having jurisdiction and as indicated in the Contract Documents. Coordinate with requirements of the following:

1. Regulatory Requirements.
2. Indoor Air Quality (IAQ) Management.
3. Noise & Acoustics Management.
4. Environmental Management.
5. Construction Waste Management.
6. Storm Water Management, including procedures for containment and response for leaks and spills.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before NPS acceptance, regardless of previously assigned responsibilities.
- B. Temporary Interruption of Services to NPS staffed buildings at Bighorn Ranger Station area: Temporary interruption of services shall not be permitted. Contractor shall provide temporary utilities during the potential interruption such that no downtime is experienced.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Temporary materials may be new or used but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.
- B. Pavement: Comply with Division 32 Sections "Asphalt Paving" and "Concrete Paving."
- C. Portable Chain-Link Fencing: Minimum 2-inch, 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide concrete or galvanized steel bases for supporting posts. Driving posts for fencing is not permitted without prior approval of the Contracting Officer.
- D. Safety Barrier Fence: Orange plastic fencing not permitted.
- E. Barrier Tape: Yellow tape Imprinted with "CAUTION: CONSTRUCTION AREA", manufactured by Reef Industries, Inc., Houston, Texas, or approved equal.
- F. Concrete Barriers: Commonly referred to as "Jersey Barrier" for protection of workers and the general public when vehicles are traveling adjacent to open excavations or the work area.
- G. Posts for Signage: Shall be on tripod legs or weighted bases. Driving posts for signage is not permitted without prior approval of the Contracting Officer.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Storage and Fabrication Sheds: Temporary weather tight sheds or other covered facilities for storage of materials subject to weather damage. Number and size of structures shall be subject to Contracting Officer's approval.
- C. Toilets: Sufficiently lighted and ventilated toilet facilities in weatherproof, sight proof, handicap accessible, sturdy enclosures with privacy locks.
 - 1. Contractor shall provide and equip one (1) toilet for exclusive NPS staff use during the duration of the project. Terms of location, relocation, and servicing shall be governed by the same requirements as the toilets for the construction workers, see section 3.2 D below.
 - 2. The contractor shall provide a keyed padlock and key to the Contracting Officer, to be kept by the fee staff to secure the toilet and prevent unauthorized use.
 - 3. The Contracting Officer shall provide approval for all agreements regarding the location and servicing of the NPS staff toilet.
- D. Temporary Kiosk: Prefabricated or built to purpose mobile unit with the following features:
 - 1. ABAAS and OSHA compliant access and workspace.
 - 2. Serviceable and easily cleanable finishes.
 - 3. Crash protection, such as Jersey barriers, and attenuation devices.
 - 4. Eaves shall extend no greater than 12" from face of building.
 - 5. Positive pressure air flow/ventilation. See Section 01 57 19.11 "Indoor Air Quality Management" for more information.
 - 6. Climate control (heating and cooling).
 - 7. Power for lighting, radio, climate control equipment, powered desk, transaction unit, and minimum two outlets for unassigned incidental use.
 - 8. Data for transaction unit and WAP.
 - 9. Transaction window – at side adjacent to incoming traffic; sliding function with a minimum 30 inch clear opening. Height of opening shall be 34" high sill to 6'-8" head.
 - 10. Front window, facing incoming traffic – minimum 5'x5' fixed window with no intermediate mullions and adjustable window covering.
 - 11. Back window, facing outgoing traffic - minimum 30" wide x 48" high fixed window with no intermediate mullions and adjustable window covering. As an alternative, may be half lite on upper half of door, also with an adjustable window covering.
 - 12. Door – half lite door with ABAAS compliant privacy lock (thumb turn, interior side) and mortise lock/deadbolt, keyed on exterior side. Provide typical weatherstripping and door sweep over galvanized steel threshold.
 - 13. Code compliant lighting for interior activities and for safe ingress and egress after dark. Exterior light shall be Dark Sky compliant.
 - 14. Variable height desk – electrically powered standing/sitting desk, width of interior of kiosk/booth.
 - 15. Moveable – to accommodate stages of construction
 - 16. Adjacent Parking – Three (3) dedicated parking spaces for the use of the NPS staff only within 100 feet of the kiosk.
 - 17. Signage for temporary kiosk shall be salvaged from one of the existing kiosks and shall be disposed of after completion of the project.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Contracting Officer authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 3. Permanent HVAC System: use of permanent HVAC system for temporary use during construction is not permitted.
- C. Spill Kits: Shall be commercially obtained spill kits of sufficient size for potential spill impact. Spill kit shall be clearly labeled to the type of spill it has been developed for and shall include at minimum:
 - 1. Bin to contain spill kit contents and for use during spill containment.
 - 2. Absorbent socks.
 - 3. Absorbent cushions.
 - 4. Absorbent pads,
 - 5. Disposal bags and ties.
 - 6. Personal protective equipment – gloves and goggles.
- D. Traffic Equipment
 - 1. Refer to civil plans for recommended detour routing, and number and type of needed directional signage.
 - 2. Provide all barricades, lights, danger signals, warning signs, traffic cones, barriers, signage, and other equipment needed to safely direct publicly owned vehicles through the construction site.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance and as directed by the Contracting Officer.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, NPS, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Storm Sewers and Drainage: Provide temporary dewatering or bypass systems for construction within Big Horn Creek.
- C. Potable water is available on site from existing water system, limited to 400 gal/day. Potable water over this amount is available to be transported to the site by the Contractor from the NPS East Headquarters area. For site supplied water, connection location(s) to be approved by the Contracting Officer. The Contractor is required to provide and install an approved backflow prevention device as well as piping if necessary to access and extract water from the provided source. Limit the amount of water used from Park sources to amount approved by Contracting Officer. Coordinate the scheduled use of this water source with the Contracting Officer. Facilities must be cleaned and maintained in a condition acceptable to the NPS. At Substantial Completion, restore these facilities to condition of water system upgrade final product.
- D. Sanitary Facilities: Provide temporary toilets, and wash facilities for use by construction personnel (and NPS staff as noted above).
 - 1. Place in approved locations secluded from public observation and convenient to work stations. Relocate as work progress requires.
 - a. Contracting Officer shall approve locations.
 - 2. Maintain and clean toilet facilities at least weekly.
 - 3. Completely remove sanitary facilities on completion of work.
 - 4. Temporary toilets shall be locked when contractor is not onsite.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Use of permanent heating and cooling system will not be allowed without written authorization from Contracting Officer. This is not advised as use of the permanent system prior to substantial completion and beginning of the government's warranty period muddies the beginning of the warranty.
 - 2. Provide and maintain adequate approved facilities, as required for safety and construction requirements, during the progress of the work. Provide ample clearance around stoves and heaters and all chimney and vent connections to prevent ignition of combustible material
 - 3. Install and maintain temporary filters when air handing equipment is used for temporary heating and cooling. This is not advised as use of the permanent system prior to substantial completion and beginning of the government's warranty period muddies the beginning of the warranty.
 - 4. Warranties for equipment used for temporary heating and cooling shall start on date of Final Acceptance.

- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead, unless otherwise indicated.
 - 2. No generators shall be left on overnight when no work is occurring.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 - 2. At worksites where traffic control measures have been used to shift path of travel, lights complying with Dark Sky requirements shall be used overnight even when no work is occurring. The intent is to provide vehicles with a safe path through the worksite.
 - 3. At worksites not adjacent to the road, no lights shall be left on overnight when no work is occurring.
- I. Telephone Service: There is a telephone service line available on site for Contractor's use. Make arrangements with Telephone Company to establish service and pay all costs.
 - 1. Cellphone Coverage: Coverage is undependable in the work zone and varies by provider.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 50 feet of building lines. Comply with NFPA 241.
 - 2. Maintain support facilities until near Substantial Completion. Remove structures, equipment, and furnishings, and terminate services after punch list is 100 percent completed or when directed by Contracting Officer. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Contracting Officer.
- B. The Contracting Officers/CMR Field Office not required.
- C. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas in same location as permanent roads and paved areas. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 - 2. Prepare subgrade and install base for temporary roads and paved areas according to Division 31 Section "Earth Moving."

3. Recondition base after temporary use, including removing contaminated material, regrading, proof rolling, compacting, and testing.
 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 32 Section "Asphalt Paving."
- D. Traffic Controls: Erect and maintain barricades, lights, danger signals, and warning signs in accordance with Manual on Uniform Traffic Control Devices (MUTCD 2009 with revisions 1 and 2, May 2012) edition.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants at all times.
 3. Illuminate barricades and obstructions at night; keep safety lights burning from sunset to sunrise.
 4. Adequately barricade and protect open cuts in or adjacent to thoroughfares.
 5. Protect pedestrian traffic by guardrails or fences.
 6. When pedestrian traffic is detoured onto a roadway, provide temporary walkways with protection as required at ends and overhead. For walkways, use lumber running parallel to direction of traffic movement and provide ramps at changes of elevation.
 7. Cover pipes, hoses, and power lines crossing sidewalks and walkways with troughs using beveled edge boards.
 8. Install barrier tape where directed by Contracting Officer. Keep a minimum of two rolls on site at all times
- E. Parking: Provide temporary or use designated areas of existing parking areas for construction personnel.
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.
1. Dumpsters on site shall not contain scented or food waste unless it is a dedicated metal bear-resistant bin, such as those provided by www.bearsaver.com or www.bearicuda.com or an approved equal.
- H. Snow Removal:
1. The contractor will be responsible for snow removal within the work area throughout the period of performance.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that

minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

- B. Temporary Erosion and Sedimentation Control: Refer to Section 01 57 13 “Temporary Erosion and Sediment Control”.
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of storm water from heavy rains.
- D. Leak and Spill Prevention: Repair leaks on equipment immediately. Do not use equipment that is leaking. Keep a supply of acceptable absorbent materials at the job site in the event of spills. Acceptable absorbent materials are those that are manufactured specifically for the containment and clean up of hazardous materials.
- E. Spill Kits: Provide spill kits within 100 feet of any activity or equipment that has the potential to produce a spill of oil, fuel, or fluid other than water within the boundaries of the park.
 - 1. Spill kit shall be of a type suitable for the fluid at risk of spilling.
 - 2. Workers shall be trained in the use of spill kits and shall be kept informed of the location of the nearest spill kit.
 - 3. Spill kits shall be kept in every contractor vehicle on the site.
- F. Tree and Plant Protection: Refer to Section 01 11 00 “Summary of Work”.
- G. Pest Control: Follow NPS requirements and practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- H. Site Enclosure Fence: Before construction operations begin, furnish and install chain link fencing in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site.
 - 2. Per the EA, no construction activities shall occur before limits are clearly defined or delineated.
 - 3. Locate vehicular gates to avoid interference with traffic on public thoroughfares.
 - 4. Locate pedestrian entrance gates as required to provide controlled personnel entry.
 - 5. Fence shall be free standing. Driving posts for fencing is not permitted without prior approval of the Contracting Officer
- I. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- J. Barricades, Warning Signs, and Lights: Comply with requirements of MUTCD for erecting structurally adequate barricades, including warning signs and lighting.

- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- L. Animal Protection: Overnight at open trenches, provide textured ramps to allow trapped animal to escape. Slope must be 3:1 (run:rise) slope or less. If ramp meeting this slope requirement is not possible given the size of the hole, the trench must be covered with secured plywood cover.
- M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of National Park Service Authority Having Jurisdiction.
 2. Hot work permits, approved through the Contracting Officer by the park's structural fire coordinator, are required for any hot work. Submittal of permit request is required no less than one week in advance of the work. Do not proceed until notified by the Contracting Officer that the permit has been approved.
 3. Responsible Person: A capable and qualified person shall be placed in charge of fire protection. The responsibilities shall include locating and maintaining fire protective equipment and establishing and maintaining safe torch cutting and welding procedures.
 4. Smoking: Smoking within buildings or temporary storage sheds is prohibited.
 5. Welding operations, with combustion-type temporary heating units, and similar sources of fire ignition shall be performed in accordance with OSHA requirements for Welding, Cutting, and Brazing. Notify Contracting Officer prior to any welding operations. Comply with NPS regulations as applicable.
 6. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Instruct personnel in methods and procedures.
 7. Hazard Control: Take all necessary precautions to prevent fire during construction. Do not store flammable or combustible liquids in existing buildings. Provide adequate ventilation during use of volatile or noxious substances.
 8. Spark Arresters: Equip all gasoline or diesel powered equipment used during periods of potential fire hazards or in potential forest and grass fire locations with spark arresters approved by the USDA Forest Service.
 - a. Written determinations of periods and areas of potential fire hazard will be issued by Contracting Officer.
 9. Buildings: Furnish a minimum of one extinguisher for each 1,500 square feet of area or major fraction thereof.
 - a. Travel distance from any work station to the nearest extinguisher shall not exceed 75 feet.
 10. Vehicles and Equipment: Provide one extinguisher on each vehicle or piece of equipment.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
 - 2. Ensure that storage of food, garbage, and other attractants are at all times properly secured to reduce potential conflict with wildlife.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor.
 - 2. At Substantial Completion, clean and renovate permanent facilities used during construction period.

END OF SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

SECTION 015713 - TEMPORARY EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Additional information concerning temporary erosion and sedimentation control may be found on the civil drawings. In case of conflict between the drawings and the information specified herein, the more stringent requirements shall govern.

1.2 SUMMARY

- A. Work Included. Furnish, install, maintain, and remove temporary erosion and sedimentation controls as specified herein, or as required to complete the work.
- B. NPS Standards and Guidelines require that water quality be protected at all times to ensure compliance with the Organic Act.
- C. Construction disturbances one acre of soil disturbance and above require an NPDES permit and a Stormwater Management Plan (SWMP) must be submitted to the Authority Having Jurisdiction (AHJ) for review and approval.
- D. Related Sections include the following:
 - 1. Division 02 Section "Selective Demolition" for removal of items of historical significance.
 - 2. Division 31 Section "Site Clearing" site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
 - 3. Division 31 Section "Earth Moving" for soil materials, site excavating, filling and grading.
 - 4. Division 31 Section "Trenching and Backfilling" for excavating and backfilling of utilities.
 - 5. Division 32 Section "Seeding" for seed mix and broadcasting rates.
 - 6. Division 32 Section "Tree Transplanting" for permanent vegetation and groundcovers.
- E. Permits and Fees: Obtain and pay for all permits and fees required for the work of this section, at least ten (10) days prior to start of construction, including erosion and sediment control and water quality permits required by the authority having jurisdiction and the Colorado Department of Public Health and Environment, Water Quality Control Division (CDPHE).
- F. Erosion Control: The Erosion and Sedimentation Control Drawings required by Contract shall be the minimum requirement to be implemented. Provide additional control as necessary to meet applicable State and Federal criteria, or as field conditions warrant subject to the Contractor's phasing and sequencing of construction activities.

1.3 DEFINITIONS

- A. Environmental Pollution and Damage: The presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances; or degrade the utility of the environment for aesthetic, cultural, or historical purposes.
- B. Best Management Practice (BMP): Erosion and sediment control devices, which may consist of silt fence, erosion control logs, erosion control fabric, riprap, etc.
- C. Storm Water Management Plan (SWMP): Identifies potential sources of pollution, practices to be used to reduce pollutants, materials and waste management, housekeeping, erosion and sediment control measures, and method to assure compliance. Plan shall be in conformance with this specification section.

1.4 SUBMITTALS

- A. Submittal Procedures: All submittals are to be made to the Contracting Officer. Refer to Division 01 Section "Submittal Procedures."
- B. Product Data: Submit manufacturer's published descriptive literature and complete specifications for manufactured products specified herein and utilized on the project.
 - 1. Geotextiles.
 - 2. Erosion Control Fabric.
- C. Permits: A copy of the following permits shall be provided to the Contracting Officer prior to construction.
 - 1. Submit a copy of the stormwater discharge and water quality permits from the Colorado Department of Public Health and Environment, Water Quality Control Division.
 - 2. Submit a copy National Pollution Discharge Elimination System (NPDES) individual or general permit and copy of the Notice of Intent (NOI).
- D. After contract award and before the pre-construction conference, prepare and submit SWMP in conformance with CDPHE requirements, NPS guidelines, and adherence to all applicable construction storm water management practices.
- E. Storm Water Management Plan (SWMP):
 - 1. The Contractor shall provide a SWMP and report addressing temporary and permanent erosion and sediment control measures.
 - 2. General Information Narrative: Site information, responsible parties, project scope, activities and materials with the potential to pollute storm water.
 - 3. Provide details for the specific BMPs to be implemented for this project.
 - 4. Vicinity map extending approximately one quarter mile beyond the boundaries of the construction site showing the construction site, surface water bodies, known springs and wetlands, known wells, general topography, and the anticipated discharge location(s) where the construction site's storm water discharges to a storm drain system or other water body. A U.S. Geological Survey (USGS) quad map may be used for showing the project

site and a one-quarter mile extension beyond the property boundaries of the construction site.

5. Project site map, clearly show boundaries of the construction site and location of BMPs, including symbols for the location of BMPs. Map shall include surface water bodies, wetlands and tributaries, topography, storm drain system intake location, and SWMP discharge points.
6. Spill prevention, including methods of containment and equipment and supplies to be stored on site for leaks and spills.
7. A schedule detailing coordination of erosion and sediment control measures with the various construction operations and stages. Include furnishing, installation, maintaining, and removal of temporary devices and the installation of permanent erosion control features.
8. Implementation, inspection and maintenance schedule.
9. The SWMP should be reviewed and modified as part of the overall process of assessing and managing storm water quality issues at the site. Erosion and sediment control measures outlined in the report shall be the minimum requirement for the construction of this project. Additional measures are to be implemented, and updated in the SWMP per authority having jurisdiction, as necessary and as required by the Contractor to control erosion and the release of sediment into the surrounding roads, natural drainageways, or existing drainage facilities.

F. Leaks and Spills

1. SWMP shall also include procedures and provisions as outlined below:
 - a. Standard Operating Procedures for minor spills, for paint, stain, solvent, glue, which are less than reportable quantities, including equipment and supplies to be stored on site.
 - b. Standard Operating Procedures for minor fuel or oil spills, which are less than 5 gallons, including equipment and supplies to be stored on site.
 - c. Standard Operating Procedures for small fuel or oil spills, 5 gallons to less than 25 gallons, including equipment and supplies to be stored on site.
 - d. Standard Operating Procedures significant fuel or oil spills, 25 gallons or more which are less than five gallons, including equipment and supplies to be stored on site.

1.5 QUALITY ASSURANCE:

- A. Regulatory Requirements: Comply with applicable State and Federal ordinances, rules and regulations concerning sedimentation control and storm water runoff.
- B. In case of conflict between the above codes, regulations, references and standards and these specifications, the more stringent requirements shall govern.
- C. Preconstruction Conference: Conduct conference at Project site as directed by the Contracting Officer prior to start of construction. Contractor to comply with requirements, which may also be included in Division 1 Section "Project Management and Coordination."
- D. Orientation Meeting: The Contractor shall be responsible for arranging and conducting a SWMP meeting/briefing to inform all parties scheduled to be on-site during the project of the measures

to be implemented for storm water pollution prevention. This may be included as part of the Pre-Construction Conference.

1. Installation of silt fences, storm drain protection, and all other forms of storm water pollution prevention control shall not begin until after this meeting has occurred.

1.6 PROJECT/SITE CONDITIONS

- A. Existing Conditions: Verify all existing conditions affecting the work of this section prior to submitting bids or proposals. Additional compensation will not be allowed for revisions or modification of work resulting from failure to verify existing conditions.

1.7 WARRANTY

- A. Temporary Erosion and Sediment Control measures shall be maintained until permanent measures are in place. All damaged, disturbed or devices filled with sediment, which may occur within the specified project warranty period, shall be corrected at no cost to the Government. Any devices damaged by erosion or sediment shall be restored to their original condition by the Contractor, at no cost to the Government.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Erosion and Sedimentation Control Materials: Provide one or more of the following materials, as shown on the plans or as applicable for site conditions:
 1. Sand bags.
 2. Silt fences.
 3. Rock socks.
 4. Rock riprap.
 5. Permanent seeding.
 6. Biodegradable sediment control logs
 7. Biodegradable twisted jute or spun-coir mesh.
 8. Drainage geotextile.
 9. Landscaping logs.
 10. Other materials proposed for use on-site.
- B. Use of straw or rice products, including “certified weed free” products, shall not be permitted. Acceptable materials for erosion control blankets and sediment logs include excelsior or coir fiber products. Jute or cotton shall be used as netting in erosion control blankets and sediment logs; plastic netting is not permitted in blankets or sediment logs.
 1. Acceptable manufactures for erosion control blankets and sediment logs include;
 - a. American Excelsior (Curlex)
 - b. Tensar
 - c. Approved Equal

C. Sediment Logs

1. Fully biodegradable.
2. Fiber: Great Lakes Aspen, naturally seed free, curled, interlocking fibers with barbed edges,
3. Netting: Totally encased, durable biodegradable tubular netting with knotted ends. Netting shall be burlap or other plant fiber. Biodegradable plastic is not acceptable.
4. Sediment log shall be Curlex Sediment Log as manufactured by American Excelsior Company, Arlington, TX, 76011, (800) 777-SOIL or approved equal.

D. Erosion Control Blankets

1. Blanket
 - a. Naturally seed free Great Lakes Aspen curled wood excelsior with 80% of the fiber \geq 6-inches in length.
 - b. 100% biodegradable.
 - c. Excelsior wood fiber
 - d. Top and bottom of blanket covered with biodegradable jute netting.
 - e. Staples shall be 100% biodegradable with a U-shaped top.
 - f. Erosion Control Blanket shall be Curlex II FibreNet as manufactured by American Excelsior Company, Arlington, TX, 76011, (800) 777-SOIL or approved equal.
2. Staples
 - a. Staples shall be E-Staple as manufactured by American Excelsior Company, Arlington, TX, 76011, (800) 777-SOIL or approved equal.

E. Landscape Logs

1. Harvest and stockpile relatively straight lodgepole logs with a diameter breast height of 8 to 12 inches for use as erosion log barriers in slope stabilization. Lodgepole logs shall be harvested from trees removed as part of demolition activities.
 - a. Break off butt-end and top-end of lodgepole logs rather than sawcut.
 - b. Lodgepole logs shall be 20-30 feet in length and shall be limbed on one side to allow 100 percent contact with the ground to provide an effective erosion barrier. Stockpile the lodgepole logs in designated storage areas as approved by the Contracting Office.
 - c. Lodgepole harvesting and installation shall be considered incidental to the temporary and permanent erosion control work.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL PROTECTION

- A. Protection of Natural Resources: Comply with applicable regulations and these specifications. Preserve the natural resources within the project boundaries and outside the limits of work performed under this Contract in their existing condition or restore to an equivalent or improved condition as approved by the Contracting Officer.

- B. Construction Zone: Arrange construction activities to minimize erosion to the maximum practical extent.
 - 1. Clearing, excavation, and grading shall be limited to those areas of the project site necessary for construction. Minimize the area exposed and unprotected.
 - 2. Determine the existing ground elevations, drainage patterns, and changes to such patterns during excavation in order to satisfactorily plan and provide materials for adequate erosion and sediment control devices.

3.2 STORM WATER MANAGEMENT PLAN

- A. Review and Acceptance: The Contractor and the Contracting Officer will jointly review the submitted SWMP and agree to any needed revisions. The Contractor shall incorporate all revisions, sign, and submit the revised plan to the Contracting Officer. The final plan will be the document enforced on the project.
 - 1. The Contractor shall maintain a current copy of the SWMP and all associated records and forms at the jobsite throughout the duration of the project.
 - 2. The SWMP shall be available at all times for inspection and use of the Contracting Officer.
 - 3. Approval of Contractor's SWMP will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.
- B. Implementation: Implement the SWMP as required throughout the construction period and maintain all BMPs in proper working order.
 - 1. Do not perform clearing and grubbing or earthwork until the SWMP has been implemented.

3.3 PLAN REVISIONS

- A. It may be necessary to revise the SWMP during construction to make necessary improvements, revisions, or to respond to unforeseen conditions noted during construction or site inspections.
- B. Negligence: Provide additional temporary BMPs made necessary by Contractor's errors or negligence at no additional cost to the Government.

3.4 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and rights-of-way according to requirements of authorities having jurisdiction.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.5 EROSION CONTROL MEASURES

- A. Erosion control measures shall consist of any and all BMPs for storm water discharges, including but not limited to silt fencing, barrier protectors, temporary soil retention blankets and stabilizers, excelsior drainage filters, landscape logs, sediment traps, berms, concrete wash-outs, hazardous material storage areas and waste management.
- B. Erosion control measures shall be used to contain only direct precipitation in the construction zone. The contained water shall be allowed to percolate into the ground or drain slowly through the drainage filter sediment traps.
- C. Reduce runoff velocity as well as direct surface runoff around and away from all fuel containment, storage, and borrow areas.
- D. Divert surface runoff around and away from cut and fill slopes.
- E. Excess water used for dust control shall be contained within the demolition areas by the erosion control measures.
- F. The Contractor shall prevent the deposition of materials onto paved areas. The Contractor shall inspect the paved areas for deposited materials weekly and remove the materials immediately.
- G. Furnish, install, maintain, and operate necessary control measures and other equipment necessary to prevent storm water pollution as described in the approved SWMP.
- H. Provide temporary erosion controls consisting of berms at the top of slopes and interceptor ditches at ends of berms and at those locations which will eliminate or minimize erosion during construction, along with temporary seeding, temporary diversion, chutes, and down pipes and lining of water courses.
- I. Maintain the available silt holding capacity of silt dams, fence traps and barriers until no longer needed. The sediment capacity of sediment retainage areas shall be at a minimum the capacity shown on the manufacturer's specifications. Prior to removal, obtain concurrence of the Contracting Officer.
- J. Remove accumulated sediment and debris from a BMP when the sediment level reaches one-half the height of the BMP, or at any time the sediment or debris adversely impacts the functioning of the BMP.
- K. Before the work begins, sufficient equipment shall be available on the site to assure that the operation and adequacy of the SWMP can be maintained.

3.6 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work of this section will be performed. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

3.7 INSTALLATION

A. Erosion and Sedimentation Control Devices. Erosion and sedimentation control measures to be taken during construction include, but are not necessarily limited to the following:

1. Apply soil stabilization within 14 days to all disturbed areas that are to be dormant for a period longer than 30 calendar days after reaching grade. Stabilize soil with mulch anchored per NPS criteria or authorities having jurisdiction. Temporarily revegetate areas that will remain in an interim condition for more than thirty (30) days.
2. Install erosion control blankets and landscape logs on all disturbed surfaces that have a slope of 3:1 (H:V) or steeper. Coordinate landscape log installation with the Contracting Officer prior to implementation.
 - a. Slopes greater than 3:1 (H:V) or greater require a minimum 6-inches topsoil placed following grading activities. Seed and cover with erosion control blankets or other approved means of temporary stabilization.
3. Roads and parking areas indicated to be paved may be covered with an appropriate aggregate base course in lieu of mulch. Temporary mulching or aggregate base course is not required if final pavement construction will take place within 30 days after grading to final contours.
4. Soils that will be stockpiled for more than 30 days must be mulched and seeded within 14 days after stockpile construction.
5. Prevent sediment from leaving the project site by installing a silt fence or other BMPs as indicated on the plans. Protect existing storm inlets adjacent to the site by an approved gravel filter.
6. Locate stone stabilization pads at all points of vehicular ingress and egress to the construction site.

B. Landscape Logs:

1. Place and anchor lodgepole logs prior to completion of work. Place lodgepole logs so that overland flow will be intercepted every 15 to 45 feet. Place logs on all erodible surfaces as directed by the Contracting Office in coordination with the NPS. Stagger and place logs in a random fashion to prevent the appearance of a pattern.
2. Place lodgepole logs so they are level and positioned perpendicular to the overland flow path of water. Dig a trench on the contour 4-6 inches deep depending on the size of the log. Place the limbed side of the log down in the trench, and backfill the log ensuring there are no gaps.
3. Anchor lodgepole logs to the slope with stakes driven into the ground on the downhill side of the log. Anchor lodgepole logs to the slopes using 2-inch x 2 in. x 2.5 ft, hardwood stakes. Reinforcing steel (No. 5), 2.5 ft. in length may be used in material where wood stakes cannot be driven. A minimum of 15 stakes shall be used to anchor lodgepole logs that are 30 feet in length. Stakes shall be driven perpendicular to the ground line to a minimum depth of 18 inches. The top of the stake shall not extend above the lodgepole log, nor shall it protrude from the ground less than one-half the diameter of the log.

C. Chemicals and Pollutants:

1. Store construction materials and chemicals that could contribute pollutants to the runoff within an enclosure, container, or dike located around the perimeter of the storage area, to prevent discharge of these materials into runoff from the construction site.

2. Locate areas used for collection and temporary storage of solid and liquid waste away from natural waterways and the storm drainage system. Provide covering or fencing as required to prevent windblown materials; construct perimeter dike to contain liquid runoff. These measures may not be necessary if materials are immediately placed in covered waste containers.
3. Perform equipment maintenance in designated areas using measures such as drip pans to control petroleum products spillage.
4. Immediately clean up and properly dispose of spills of construction related materials such as paints, solvents, or other chemicals.

3.8 REPORTING

- A. If a discharge occurs or if the project receives a written notice or order from any regulatory agency, the Contractor will immediately notify the Contracting Officer and will file a written report to the AHJ within seven days of the discharge event, notice, or order. Corrective measures shall be implemented immediately following the discharge, notice, or order. The report to the AHJ shall contain the following items at a minimum:
 1. The date, time, location, nature of operation, and type of discharge, including the cause or nature of the notice or order.
 2. The BMPs deployed before the discharge event, or prior to receiving the notice or order.
 3. The date of deployment and type of BMPs deployed after the discharge event, or after receiving the notice or order, including additional BMPs installed or planned to reduce or prevent re-occurrence.
 4. An implementation and maintenance schedule for any affected BMPs.

3.9 SEDIMENT DISPOSAL

- A. Sediment excavated from BMPs shall be disposed on the site with general fill, or with topsoil. Sediment shall be allowed to dry out as required before reuse.
- B. Contractor shall place the sediment removed from traps and other structures where it will not enter a storm drain or watercourse and where it will not immediately reenter the basin.

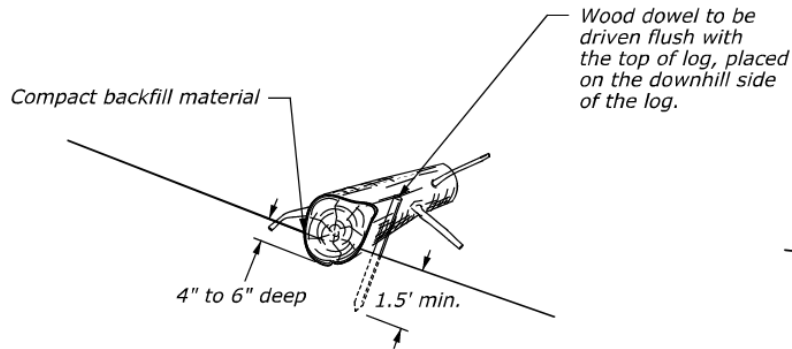
3.10 FINAL STABILIZATION AND LONG-TERM MANAGEMENT

- A. Final stabilization shall be achieved through permanent vegetation, installation of landscape logs, and landscaping after construction of all buildings and paved surfaces.
- B. With approval of the Contracting Officer and authorities having jurisdiction, temporary erosion and sediment control measures may be removed within 30 days after final site stabilization is achieved, after the site has reached 70% of the pre-development stabilization rate, or after temporary measures are no longer needed.
- C. Inspection and Maintenance: Inspect erosion and sediment control measures weekly during construction. In addition, inspect all facilities immediately after any significant runoff or snowmelt which results in runoff. Repair or otherwise mitigate any damage to the erosion and sediment control facilities at no additional cost to the Government.

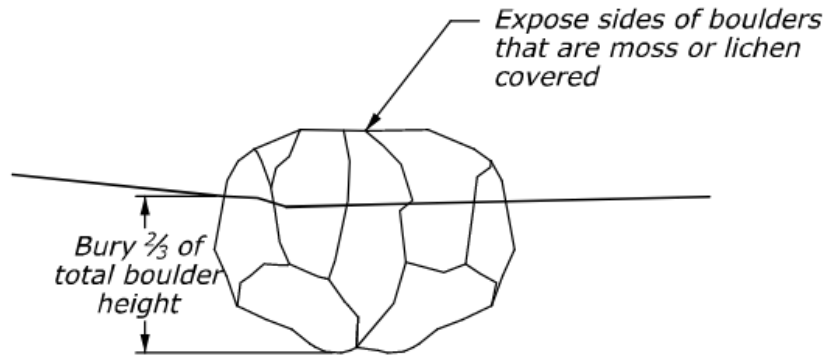
3.11 REMOVAL OF TEMPORARY STORM WATER POLLUTION CONTROL MEASURES

- A. All temporary control measures shall be removed with permission of the Contracting Officer within 20 working days after final acceptance of the project, and/or once grading is completed and slopes have stabilized.
- B. Leave the site and work area in a clean condition.

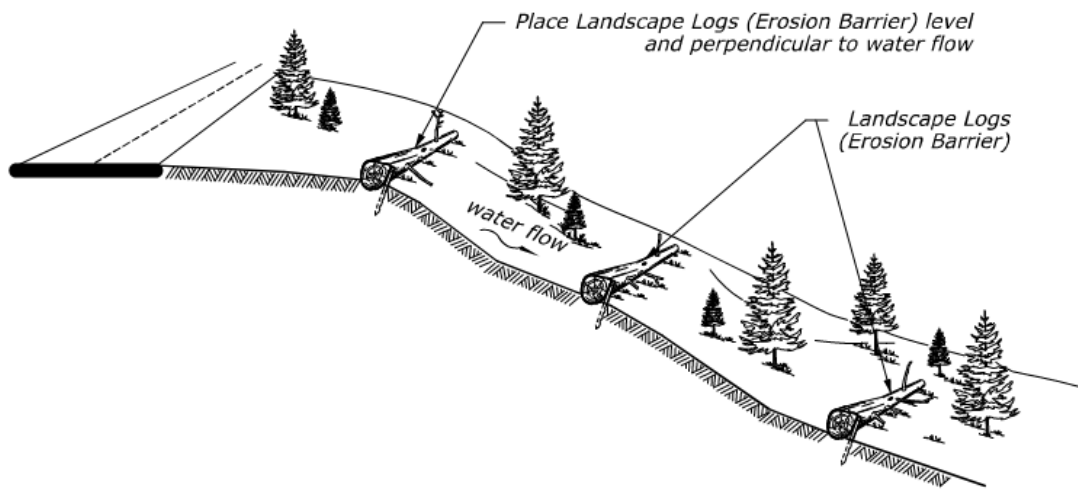
3.12 TYPICAL LANDSCAPE LOG AND EROSION CONTROL BOULDER DETAILS



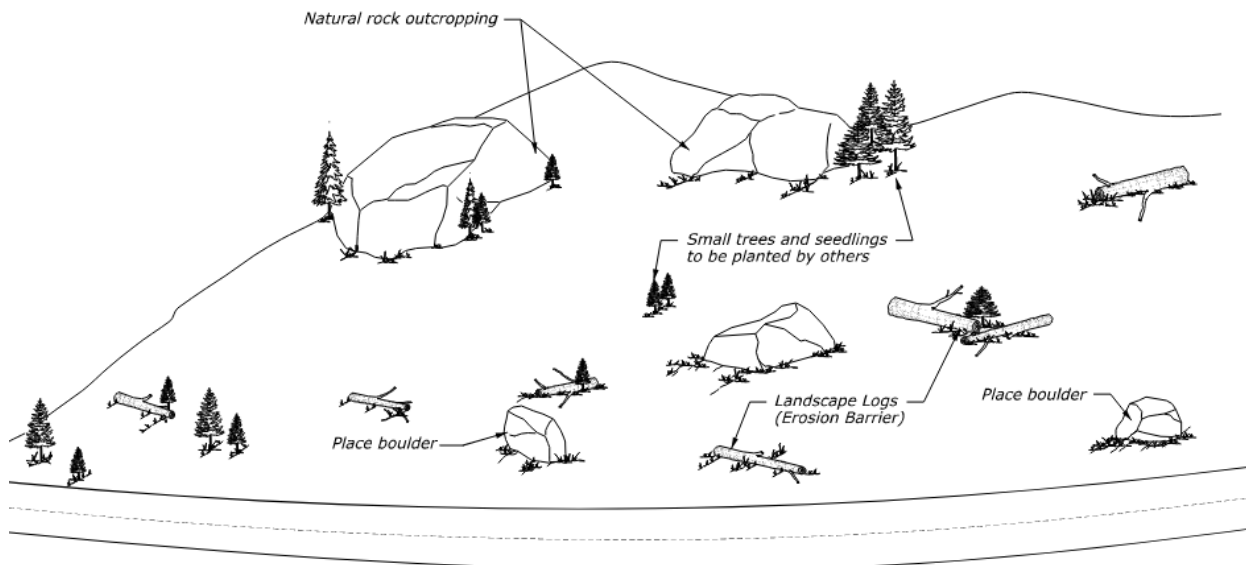
LOG PLACEMENT DETAILS



ROCK PLACEMENT DETAILS



FILL SLOPE LANDSCAPING



CUT SLOPE LANDSCAPING

END OF SECTION 015713

SECTION 01 57 19.11 – INDOOR AIR QUALITY MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 57 19.11 “Indoor Air Quality Management” includes:
 - 1. Special requirements for Indoor Air Quality (IAQ) management during construction operations.
 - a. Control of emissions during construction.
 - b. Moisture control during construction.
 - 2. Procedures for testing baseline IAQ. Baseline IAQ requirements specify maximum indoor pollutant concentrations for acceptance of the facility.
 - 3. Temporary kiosk – requirement for adequate ventilation and positive pressure for vehicle emission control.

1.2 DEFINITIONS

- A. Definitions pertaining to sustainable development: As defined in ASTM E2114.
- B. Adequate ventilation: Ventilation, including air circulation and air changes, required to cure materials, dissipate humidity, and prevent accumulation of particulates, dust, fumes, vapors, or gases.
- C. Hazardous Materials: Any material that is regulated as a hazardous material in accordance with 49 CFR 173, requires a Material Safety Data Sheet (MSDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have the potential to meet the definition of a Hazardous Waste in accordance with 40 CFR 261. Throughout this specification, hazardous material includes hazardous chemicals.
 - 1. Hazardous materials include: pesticides, biocides, and carcinogens as listed by recognized authorities, such as the Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC).
- D. Indoor Air Quality (IAQ): The composition and characteristics of the air in an enclosed space that affect the occupants of that space. The indoor air quality of a space refers to the relative quality of air in a building with respect to contaminants and hazards and is determined by the level of indoor air pollution and other characteristics of the air, including those that impact thermal comfort such as air temperature, relative humidity and air speed.
- E. Interior final finishes: Materials and products that will be exposed to interior occupied spaces; including flooring, wall covering, finish carpentry, and ceilings.

- F. Packaged dry products: Materials and products that are installed in dry form and are delivered to the site in manufacturer's packaging; including carpets, resilient flooring, ceiling tiles, and insulation.
- G. Wet products: Materials and products installed in wet form, including paints, sealants, adhesives, special coatings, and other materials which require curing.

1.3 QUALITY ASSURANCE

- A. Inspection and Testing Lab Qualifications: Minimum of 5 years experience in performing the types of testing specified herein.

1.4 SUBMITTALS

- A. Indoor Air Quality (IAQ) Management Plan: After award and before the Pre-construction conference, prepare and submit an IAQ Management Plan including, but not limited to, the following:

1. Procedures for control of emissions during construction.
 - a. Identify schedule for application of interior finishes: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.
 - b. Identify potential sources of odor and dust.
 - c. Identify construction activities likely to produce odor or dust.
 - d. Identify areas of project potentially affected, especially occupied areas.
 - e. Evaluate potential problems by severity and describe methods of control.
 - f. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
 - g. Describe cleaning and dust control procedures.
 - h. Describe coordination with commissioning procedures.
2. Procedures for moisture control during construction.
 - a. Identify porous materials and absorptive materials.
 - b. Identify schedule for inspection of stored and installed porous and absorptive materials.
3. Revise and resubmit Plan as required by Contracting Officer.
 - a. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.
4. Equipment to be provided with temporary kiosk to address vehicle emissions. Kiosk requires positive pressure air flow when occupied.

- B. Product Data:

1. Submit product data for filtration media used during construction and during operation. Include Minimum Efficiency Reporting Value (MERV).
2. Submit product data for positive pressure method developed for the temporary kiosk.
3. Material Safety Data Sheets: Submit MSDSs for inclusion in Operation and Maintenance Manual for the following products.
 - a. Adhesives.
 - b. Caulking and sealants.
 - c. Insulating materials.
 - d. Paint.
 - e. Clear finish for wood surfaces.
 - f. Lubricants.
 - g. Cleaning products.

C. Inspection and Test Reports:

1. Moisture control inspections.
2. Moisture content testing.
3. Moisture penetration testing.
4. Microbial Growth testing.
5. Positive Pressure test for kiosks, temporary and permanent.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 IAQ MANAGEMENT - EMISSIONS CONTROL

- A. During construction operations, follow the recommendations in SMACNA IAQ Guidelines for Occupied Buildings under Construction.
- B. HVAC Protection:
 1. Seal return registers during construction operations.
 2. Provide temporary exhaust during construction operations
 3. To the greatest extent possible, isolate and/or shut down the return side of the HVAC system during construction. When ventilation system must be operational during construction activities, provide temporary filters at all air inlets (returns) and at all locations for filters prescribed in the design.
 4. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.
- C. Source Control: Provide low and zero VOC materials as specified.
- D. Pathway Interruption: Isolate areas of work as necessary to prevent contamination of clean or occupied spaces. Provide pressure differentials and/or physical barriers to protect clean or occupied spaces.

- E. Housekeeping: During construction, maintain project and building products and systems to prevent contamination of building spaces.
- F. Temporary Ventilation: For materials/products that generally require ventilation for off gassing, provide an ACH (air changes per hour) of 1.5 or more and as follows:
 - 1. Provide minimum 48 hour pre-ventilation of packaged dry products prior to installation. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant sources and residues. Provide a temperature range of 60 degrees F minimum to 90 degree F maximum continuously during the ventilation period. Do not ventilate within limits of Work unless otherwise approved by Contracting Officer.
 - 2. Provide adequate ventilation during and after installation of interior wet products and interior final finishes.
 - 3. Provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE 52.2 during construction. Coordinate with work of Division 23 (15), Heating Ventilating and Air Conditioning (HVAC).
- G. Scheduling: Schedule construction operations involving wet products prior to packaged dry products to the greatest extent possible.
- H. Flush-Out: After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total air volume of 14,000 cu.ft. of outdoor air per sq.ft. of floor area while maintaining an internal temperature of at least 60 degrees F and relative humidity no higher than 60%.
 - 1. Obtain Contracting Officers concurrence that construction is complete enough before beginning flush-out.
 - 2. If additional construction involving materials that produce particulates or any of the specified contaminants is conducted during or after flush-out.
 - 3. Install new HVAC filtration media in all locations identified to have permanent filtration in the contract documents after completion of flush-out and before occupancy or further testing.
- I. Positive Pressure Air Flow Equipment
 - 1. Make-up air to the kiosks to be provided to maintain positive pressurization in the space and protect individuals within from toxic car fume infiltration. Air quantity to be provided to maintain a discharge of 100fpm (ASHRAE 110 for fume hood capture velocities) across open kiosk windows when fully open. Relief system to be provided in temporary kiosk and sized to relieve full make-up air CFM when all windows are closed at a pressure drop maximum of 0.15" wc.
 - 2. Provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE 52.2 during construction. Coordinate with work of Division 23 (15), Heating Ventilating and Air Conditioning (HVAC).

3.2 IAQ MANAGEMENT - MOISTURE CONTROL

- A. Housekeeping:
 - 1. Keep materials dry. Protect stored on-site and installed absorptive materials from moisture damage.

2. Verify that installed materials and products are dry prior to sealing and weatherproofing the building envelope.
 3. Store interior absorptive materials only after building envelope is sealed and weatherproofed.
- B. Inspections: Document and report results of inspections; state whether or not inspections indicate satisfactory conditions.
1. Examine materials for dampness as they arrive. If acceptable to Contracting Officer, dry damp materials completely prior to installation; otherwise, reject materials that arrive damp.
 2. Examine materials for mold as they arrive and reject materials that arrive contaminated with mold.
 3. Inspect stored and installed absorptive materials regularly for dampness and mold growth. Inspect after each rain event if stored at Sheep Lakes staging area, weekly if stored within construction limits.
 - a. Where stored on-site or installed absorptive materials become wet, notify Contracting Officer. Inspect for damage. If acceptable to the Contracting Officer, dry completely prior to closing in assemblies; otherwise, remove (in accordance with the Waste Management Plan) and replace with new materials.
 4. Site drainage: Verify that final grades of site work and landscaping drain surface water and ground water away from the building.
 5. Weather-proofing: Inspect moisture control materials as they are being installed. Include the following:
 - a. Air barrier: Verify air barrier is installed without punctures and/or other damage. Verify air barrier is sealed completely.
 - b. Flashing: Verify correct shingling of the flashing for roof, walls, windows, doors, and other penetrations.
 - c. Vapor Barrier: Verify that vapor barrier is installed in accordance with the Contract documents.
 - d. Insulation layer: Verify insulation is installed without voids.
 - e. Roofing: In accordance with ASTM D7186 Standard Practice for Quality Assurance Observation of Roof Construction and Repair
 6. Plumbing: Verify satisfactory pressure test of pipes and drains is performed before closing in and insulating lines.
 7. HVAC: Inspect HVAC system as specified in Section 01 91 14 "Total Building Commissioning". And, inspect HVAC to verify:
 - a. condensate pans are sloped and plumbed correctly;
 - b. access panels are installed to allow for inspection and cleaning of coils and ductwork downstream of coils;
 - c. ductwork and return plenums are air sealed;
 - d. duct insulation is installed and sealed; and
 - e. chilled water line and refrigerant line insulation are installed and sealed.
- C. Schedule:

1. Schedule work such that absorptive materials, including but not limited to porous insulations, paper-faced gypsum board, ceiling tile, and finish flooring, are not installed until they can be protected from rain and construction-related water.
 2. Weather-proof as quickly as possible. Schedule installation of moisture-control materials, including but not limited to air barriers, flashing, exterior sealants and roofing, at the earliest possible time.
- D. Testing for Moisture Content: Test moisture content of porous materials and absorptive materials to ensure that they are dry before sealing them into an assembly. Document and report results of testing. Where tests are not satisfactory, dry materials and retest. If satisfactory results cannot be obtained with retest, remove and replace with new materials.
1. Concrete: Moisture test prior to finish flooring application as specified in Division 09. Moisture test must be within manufacturer's installation parameters prior to installation of floor finish.
 - a. ASTM D4263 Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
 - b. ASTM F1869 Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
 - c. ASTM F2170 Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes
 2. Wood: Moisture test as per ASTM D4444 - Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters; unless otherwise indicated acceptable upper limits for wood products are < 20% at center of piece; < 15% at surface.
- E. Testing for Moisture Penetration:
1. Windows: Test as per ASTM E1105 Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference; unless otherwise indicated, acceptable upper limits are no leakage for 60 minutes.
 2. Exterior Walls:
 - a. Air tightness of the enclosure test: ASTM E779 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization or ASTM E1827 Standard Test Methods for Determining Air tightness of Buildings Using an Orifice Blower Door; acceptable upper limits are 0.25 CFM/sf or less at 50 Pascal's.
 - b. Water Leakage: Review as per ASTM E2128 Standard Guide for Evaluating Water Leakage of Building Walls.

END OF SECTION 01 57 19.11 – INDOOR AIR QUALITY MANAGEMENT

SECTION 01 57 19.12 – NOISE & ACOUSTICS MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 57 19.12 “Noise and Acoustics Management” includes:
 - 1. Special requirements for noise and acoustics management during demolition, excavation, and construction operations.

1.2 DEFINITIONS

- A. Ambient noise level: The total noise associated with a given environment, being usually a composite of normal or existing sounds from all sources near and far, excluding the noise source at issue.
- B. Daytime: The hours from 7 a.m. to 9 p.m. on weekdays and 9 a.m. to 9 p.m. on weekends and holidays.
- C. Nighttime: All non-daytime hours.
- D. Property line: The real or imaginary line along the ground surface and its vertical extension, which separates real property owned or controlled by one person from contiguous real property owned or controlled by another person or from any public right-of-way or from any public space.
- E. Receiving noise area: Any real property where people live or work and where noise is heard, excluding the project or source area.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 NOISE MANGEMENT

- A. Noise Control: Perform demolition, excavation, and construction operations to minimize noise. Perform noise-producing work in less sensitive hours of the day or week as directed by the Contracting Officer.
- B. Repetitive and/or intermittent, high-level noise: Permitted only during Daytime.

- 1. Do not exceed the following dB(A) limitations at 50 feet:

Sound Level in dB(A)

70

Time Duration of Impact Noise

More than 12 minutes in any hour

2. Maximum permissible construction equipment noise levels at 50 feet:

<u>EARTHMOVING</u>	<u>dB(A)</u>	<u>MATERIALS HANDLING</u>	<u>dB(A)</u>
Front Loaders	75	Concrete Mixers	75
Backhoes	75	Concrete Pumps	75
Dozers	75	Cranes	75
Tractors	75	Derricks Impact	75
Scrapers	80	Pile Drivers	95
Graders	75	Jack Hammers	75
Trucks	75	Rock Drills	80
Pavers, Stationary	80	Pneumatic Tools	80
Pumps	75	Saws	75
Generators	75	Vibrators	75
Compressors	75		

C. Ambient Noise:

1. Maximum noise levels (dB) for receiving noise area at property line shall be as follows:

- | | | |
|----|--------------------------------------|------------------------------------|
| a. | Residential receiving area | Daytime: 65 dB
Nighttime: 45 dB |
| b. | Commercial/Industrial receiving area | Daytime: 67 dB
Nighttime: 65 dB |

2. In the event the existing local ambient noise level exceeds the maximum allowable receiving noise level (dB), the receiving noise level maximum for construction operations shall be adjusted as follows:

- | | |
|----|---|
| a. | Residential receiving area: Maximum 3 additional dB above the local ambient as measured at property line. |
| b. | Commercial/Industrial receiving area: Maximum 5 additional dB above the local ambient as measured at the property line. |

3.2 FIELD QUALITY CONTROL

A. Assess potential effects of construction noise on park visitors and NPS staff in accordance with ASTM E1686 and as follows:

1. Ambient noise measurement: Measure at 100 feet beyond the construction limit at a height of at least four (4) feet above the immediate surrounding surface. Average the ambient noise level over a period of at least 15 minutes.

B. Monitor noise produced from construction operations in accordance with ASTM E1780.

END OF SECTION 01 57 19.12 – NOISE & ACOUSTICS MANAGEMENT

SECTION 01 67 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 67 00 "Product Requirements" includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and environmental requirements.

1.2 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
- B. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.
- C. Definitions pertaining to sustainable development: As defined in ASTM E2114.
- D. Biobased Materials: As defined in the Farm Security and Rural Investment Act, for purposes of Federal procurement of biobased products, "biobased" means a "commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials." Biobased materials also include fuels, chemicals, building materials, or electric power or heat produced from biomass as defined by The Biomass Research and Development Act of 2000.
 - 1. Biobased content: The amount of biobased carbon in the material or product as a percentage of weight (mass) of the total organic carbon in the material or product.
- E. Chain-of-Custody: Process whereby a product or material is maintained under the physical possession or control during its entire life cycle.
- F. Environmentally preferable products: Products and services that have a lesser or reduced effect on the environment in comparison to conventional products and services. Refer to EPA's Final Guidance on Environmentally Preferable Purchasing for more information <http://www.epa.gov/epp/guidance/finalguidancetoc.htm>.
- G. Stewardship: Responsible use and management of resources in support of sustainability.
- H. Sustainability: The maintenance of ecosystem components and functions for future generations.

1. Recycled Content Materials: Products that contain pre-consumer or post-consumer materials as all or part of their feedstock. Recycled content claim shall be consistent with ISO 140001 Standard for the Use of Environmental Marketing Claims.
2. Rapidly Renewable Material: Material made from plants that are typically harvested within a ten-year cycle.
3. Regional Materials: Materials that are manufactured and extracted, harvested, or recovered within a radius of 500 miles from the Project location.

1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

- B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Contractor is encouraged to obtain materials in biodegradable or recyclable/reusable packaging which uses the minimum amount of packaging possible.

- C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weather tight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

1.5 PACKAGING

- A. Where Contractor has the option to provide one of the listed products or equal, preference shall be given to products with minimal packaging and easily recyclable packaging as defined in ASTM D5834.
- B. Maximize use of source reduction and recycling procedures outlined in ASTM D5834.

1.6 ENVIRONMENTALLY PREFERABLE PRODUCTS

- A. Provide environmentally preferable products to the greatest extent possible.
 - 1. To the greatest extent possible, provide products and materials that have a lesser or reduced effect on the environment considering raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and/or disposal of the product.
 - 2. Eliminate the use of ozone depleting compounds during and after construction where alternative environmentally preferable products are available, consistent with either the Montreal Protocol and Title VI or the Clean Air Act Amendments of 1990, or equivalent overall air quality benefits that take into account life cycle impacts.
 - 3. Use products meeting or exceeding EPA's recycled content recommendations for EPA-designated products. Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% (based on cost) of the total value of the materials in the project.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Contracting Officer.
 - 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Contracting Officer.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
 - 3. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.

- C. Submittal Time: Comply with requirements in Division 01 Section 01 77 00 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Government reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Contracting Officer will make selection.
 - 5. Where products are accompanied by the term "match sample," sample to be matched is Governments.
 - 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
- B. Product Selection Procedures:
 - 1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements or approved equal.
 - 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements or approved equal.
 - 3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements or approved equal.
 - 4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements or approved equal.
 - 5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
 - 6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
 - 7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product, system, or approved equal.

8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers, or approved equal. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches the sample. Contracting Officers decision will be final on whether a proposed product matches.
 - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Contracting Officer will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Contracting Officer will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions: Contracting Officer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Contracting Officer will return requests without action, except to record noncompliance with these requirements:
 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and Contracting Officers, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION

3.1 PROTECTION AFTER INSTALLATION

- A. Provide adequate coverings as necessary to protect installed materials from damage resulting from natural elements, traffic, and subsequent construction. Remove when no longer needed.

END OF SECTION 01 67 00 - PRODUCT REQUIREMENTS

SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 73 29 "Cutting and Patching" includes procedural requirements for cutting and patching on buildings that do not contain Historic Fabric.
- B. Includes repair of Pump House wood shingle roofing. Repair most damaged shingles. Anticipate 15% replacement of shingles.

1.2 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
 - 1. Replacement of the pump house roof sheathing is not anticipated to be complete replacement with no anticipated replacement of structural elements.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 1. Operational elements inside the pump house are all anticipated to be replaced. Sequence of construction shall ensure that new operational elements shall be protected from damage from removal of pump house roof.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Contracting Officer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.3 SUBMITTAL

- A. Product Data:
 - 1. Treated wood shingles – provide information regarding:
 - a. Wood species
 - b. Shingle sizes and thickness
 - 2. Roofing nails – provide information regarding:
 - a. Size and type.

- B. Samples:
 - 1. Actual sample of proposed treated wood shingle for review by Contracting Officer.

1.4 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.
- B. Pump House Shingles: Use treated wood shingles matching the thickness and size of replaced shingles. Note that shingle sizes vary in a specific pattern that shall be maintained.
 - 1. Anticipate replacement of 15% of the shingles. Prioritize replacement of worst damaged shingles first.
 - 2. Review shingle replacement strategy with Contracting Officer prior to start of repair.
- C. Roofing Nails:
 - 1. Stainless steel, Type 316, box-type wire nails, sharp pointed and of sufficient length to fasten proposed shingles and penetrate sheathing.
 - 2. ASTM F1667

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.

- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even

surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

4. Ceilings: Patch, repair, or re-hang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight condition.

D. Roof repair:

1. Inspection: Select areas of worst damage/deterioration (aggregating to 15% of roof area).
2. Identify sizes of shingles to be replaced, as new shingles shall match size of replaced shingles.
3. Remove shingles from top down (from ridge to eave edge).
4. Install shingles from bottom up (from eave edge to ridge).
5. Spacing of shingles shall match existing pattern and spacing.
6. Fasten with specified stainless steel roofing nails of sufficient length to penetrate sheathing.
7. Maintain existing shingle exposure.
8. Ridge Units: Install over ridge and fasten with nails of sufficient length to penetrate shingles and sheathing below.
 - a. Maintain same exposure dimension as existing ridge units.
 - b. Maintain existing lapping scheme.

- E. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 01 73 29 - CUTTING AND PATCHING

SECTION 01 73 40 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 73 40 "Execution" includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Examination.
 - 2. Preparation.
 - 3. Construction layout.
 - 4. Field engineering and surveying.
 - 5. General installation of products.
 - 6. Quantity Surveys.
 - 7. Progress cleaning.
 - 8. Starting and adjusting.
 - 9. Protection of installed construction.
 - 10. Correction of the Work.

1.2 SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.
- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- C. Certified As-built Surveys: Submit two copies signed by land surveyor or professional engineer.
- D. Quantity Surveys: Submit electronic copies showing quantities of work performed and actual construction completed and in place.

1.3 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions, Utilities and Site Improvements: The existence and location of site improvements, underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 - 1. Before construction, verify the existence and location and elevations of existing construction including mechanical and electrical systems and services, sanitary sewer, storm sewer, and water-service piping.
 - 2. Before construction, verify the location and points of connection of utility services.
 - 3. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to the Contracting Officer in accordance with Section 01 31 00 "Project Management and Coordination".

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the existing benchmarks. If discrepancies are discovered, notify Contracting Officer promptly.
- B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify the Contracting Officer when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the established standard.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by NPS.

3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations. Controls that are destroyed by Contractor will be replaced by the Contractor at their expense.
 - 1. Existing Monuments: All benchmarks, land corners, and triangulation points, established by other surveys, existing within the construction area shall be preserved. If existing monuments interfere with the work, secure written permission before removing them.
- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with NPS requirements for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

- C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by the Contracting Officer.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 QUANTITY SURVEYS

- A. Quantity surveys shall be conducted, and the data derived from these surveys shall be used in computing the quantities of work performed and the actual construction completed and in place.
- B. The Contractor shall conduct the original and final surveys and surveys for any periods for which progress payments are requested. All these surveys shall be conducted under the direction of the Contracting Officer unless the Contracting Officer waives this requirement in a specific instance. The Government shall make such computations as are necessary to determine the quantities of work performed or finally in place. The Contractor shall make the computations based on the surveys for any periods for which progress payments are requested.
- C. Promptly upon completing a survey, the Contractor shall furnish the originals of all field notes and all other records relating to the survey or to the layout of the work to the Contracting Officer, who shall use them as necessary to determine the amount of progress payments. The Contractor shall retain copies of all such material furnished to the Contracting Officer.

3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - 3. Contractor shall provide progress cleaning that minimizes sources of food, water, and harborage available to pests.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
 - 1. Utilize non-toxic cleaning materials and methods.
 - a. Comply with GS 37 for general purpose cleaning and bathroom cleaning.
 - b. Use natural cleaning materials where feasible. Natural cleaning materials include:

- 1) Abrasive cleaners: substitute 1/2 lemon dipped in borax.
 - 2) Ammonia: substitute vinegar, salt and water mixture, or baking soda and water.
 - 3) Disinfectants: substitute 1/2 cup borax in gallon water.
 - 4) Drain cleaners: substitute 1/4 cup baking soda and 1/4 cup vinegar in boiling water.
 - 5) Upholstery cleaners: substitute dry cornstarch.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces : Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- K. Final Cleaning: At completion of Work, remove all remaining waste materials, rubbish, tools, equipment, machinery and surplus materials, and clean all exposed surfaces; leave Project clean and ready for occupancy.
1. Provide final cleaning in accordance with ASTM E1971.

3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section 01 40 00 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section 01 73 29 "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 40 - EXECUTION

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 74 19 “Construction Waste Management and Disposal” includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.

1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Solid Waste: Garbage, debris, sludge, or other discharged material (except hazardous waste) including solid, liquid, semisolid, or contained gaseous materials resulting from domestic, industrial, commercial, mining, or agricultural operations.
- D. Debris: Non-hazardous solid waste generated during the construction, demolition, or renovation of a structure which exceeds 2.5 inch (60 mm) particle size that is: a manufactured object; plant or animal matter; or natural geologic material (e.g. cobbles and boulders). A mixture of debris and other material such as soil or sludge is also subject to regulation as debris if the mixture is comprised primarily of debris by volume, based on visual inspection.
- E. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- F. Environmental Pollution and Damage: The presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances; or degrade the utility of the environment for aesthetic, cultural, or historical purposes.
- G. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.
- H. Hazardous Materials: Any material that is regulated as a hazardous material in accordance with 49 CFR 173, requires a Material Safety Data Sheet (MSDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have the potential to meet the definition of a Hazardous Waste in accordance with 40 CFR 261.

- I. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- J. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

1.3 PERFORMANCE GOALS

- A. General: As a goal, this project shall minimize the creation of construction, deconstruction, and demolition waste to protect and restore natural habitat and resources. Factors that contribute to waste such as over packaging, improper storage, ordering error, poor planning, breakage, mishandling, and contamination shall be minimized. A Waste Management Plan shall be developed to ensure that to the extent practical, existing site and building materials are reused, salvaged, or recycled. Waste disposal in landfills shall be minimized.
- B. Salvage /Recycle Goals: To extent practical, develop waste management plan that results in end-of-Project rates for salvage/recycling of 50 percent by weight of total waste generated by the Work. The following waste categories, at a minimum, shall be diverted from a landfill:
 - 1. Land clearing debris (chipped debris can be used on site for mulch or erosion control)
 - 2. Clean dimensional wood, palettes
 - 3. Plywood, OSB, and particle board
 - 4. Concrete (can be ground and used for fill on site)
 - 5. Asphaltic concrete (can be ground and used for fill on site)
 - 6. Cardboard, paper, packaging, newsprint
 - 7. Metals (from banding, stud trim, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze)
 - 8. Gypsum drywall—unpainted
 - 9. Non-hazardous paint and paint cans
 - 10. Beverage containers: Aluminum, glass, and plastic containers
 - 11. Insulation
 - 12. Ceiling grid and tiles
 - 13. Ductwork
 - 14. Wiring
 - 15. Other mixed construction and demolition waste as appropriate
- C. If any additional waste materials encountered during the deconstruction/demolition or construction phase are found to contain lead, asbestos, PCBs, (such as fluorescent lamp ballasts), or other harmful substances, they are to be handled and removed in accordance with local, state, and federal laws and requirements concerning hazardous waste.
 - 1. See Appendix C for the hazmat report for the three existing kiosks and office building.
- D. Salvage/Recycle Requirements: Government goal is to salvage and recycle as much nonhazardous demolition and construction waste as possible including the following materials:
 - 1. Old green safe that is within the wall cupboard in the current office. To be salvaged and placed in a corner of the storage room in the new building.
 - 2. Arrowhead from entrance sign.

3. Leftover granite veneer from the construction of retaining walls and Bid Option 5.
4. Select road signs (see site demolition plan).
5. Ponderosa pines to be relocated as part of the project.

1.4 SUBMITTALS

- A. Waste Management Plan: After award of the contract and prior to the scheduled Pre-Construction Conference, the Contractor shall submit a draft Waste Management Plan to the Contracting Officer for approval. Submit electronic copy of the plan. Revise and resubmit Plan as required by the Contracting Officer. Approval of the Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.
- B. Landfill and Incinerator Disposal Records: For hazardous materials only indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- C. Closeout Submittals
 1. With Closeout Submittals, submit a summary of the Project Waste Management Plan worksheet for solid waste disposal and diversion.
 - a. Include the following information:
 - 1) Quantity of Construction and Demolition Waste Sent to Landfill. Quantity may be recorded in lbs, tons, cy compacted or cy uncompacted.
 - 2) Quantity of Construction Waste and Demolition Waste salvaged or recycled. Itemize type of waste and include quantity of each. Itemized items may include: asphalt, wood pallets, etc.
 - 3) Waste Reduction Calculations: Calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Waste Management Meeting: Conduct separate meeting or cover in the Pre-Construction Conference and comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
 2. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.

3. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
4. Review waste management requirements for each trade.

PART 2 - PRODUCTS

2.1 WASTE MANAGEMENT PLAN

- A. General: Develop plan consisting of waste identification and waste reduction work plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing and construction waste generated by the Work.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator.
 1. Salvaged Materials for Reuse: List materials that will be salvaged and reused in this Project.
 2. Recycled Materials: List materials that will be recycled in this Project.
 3. Disposed Materials: Indicate how and where materials will be disposed of.
 4. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement waste management plan as approved by the Contracting Officer. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator: Identify a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.
- C. The Contractor shall establish contacts with local recycling and reuse companies to set up the lines of responsibility. Contractor shall be responsible for coordinating with these companies in terms of identifying materials, pickup schedules, and standard quality for recycled materials.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- E. Separation facilities:

1. The Contractor shall designate and the Contracting Officer shall approve a specific area or areas to facilitate separation of materials for potential reuse, salvage, recycling, and return.
 2. Waste and recycling bins are to be placed near each other, and close to the point of waste generation but out of the traffic pattern.
 3. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid co-mingling of materials.
 4. Bins shall be protected during non-working hours from off-site contamination.
 5. The garbage dumpsters should be checked periodically to monitor recyclables being thrown away or if there are undocumented materials that could be recycled.
- F. Materials handling procedures: Materials to be recycled shall be protected from contamination and shall be handled, stored, and transported in a manner that meets the requirements set by the designated facilities for acceptance. Establish a defined area for the operations of each trade, especially woodcutting so that off-cuts will be kept in one area and can be sorted by dimension for future reuse.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until installation.
 4. Protect items from damage during transport and storage.
 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale and Donation: Not permitted on Project site.
- C. Salvaged Items for Governments Use:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Government.
 4. Transport items to storage area designated by Government.
 5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

- a. Inspect containers and bins for contamination and remove contaminated materials if found.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste off Governments property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

- A. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.
 1. Crush asphaltic concrete paving and screen to comply with requirements in Division 31 Section "Earth Moving".
- B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 1. Pulverize concrete to maximum 1-1/2-inch size.
- C. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- D. Metals: Separate metals by type.
 1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- E. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
- F. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- G. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
 1. Separate suspension system, trim, and other metals from panels and tile and sort with other metals.
- H. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- I. Plumbing Fixtures: Separate by type and size.
- J. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- K. Lighting Fixtures: Separate lamps by type and protect from breakage.

- L. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.
- M. Conduit: Reduce conduit to straight lengths and store by type and size.
- N. Electronic Products: Ensure that all non-usable electronic products are reused, donated, sold, or recycled using environmentally sound management practices at end of life.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Site-Clearing Wastes: Chip brush, branches, and trees at landfill facility.
- C. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- D. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.
 - 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Government's property and legally dispose of them.

END OF SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 77 00 "Closeout Procedures" includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Project Record Drawings.
 - 2. Closeout Submittals.
 - 3. Substantial Completion and Final Inspection.
 - 4. Final Acceptance of the Work.
 - 5. Warranties.
 - 6. Final Cleaning.

1.2 PROJECT RECORD DRAWINGS

- A. Maintain one complete full-size set of contract drawings and one full-size set of vendor-supplied drawings. Clearly mark changes, deletions, and additions using National Park Service drafting standards to show actual construction conditions. Show additions in red, deletions in green and special instructions in blue.
- B. Keep record drawings current. Make record drawings available to the Contracting Officer for inspection at the time of monthly progress payment requests. If project record drawings are not current, the Contracting Officer may retain an appropriate amount of the progress payment.
- C. On completion of the total project, submit complete record drawings. Include all shop drawings, sketches, and additional drawings that are to be included in the final set, with clear instructions showing the location of these drawings.
 - 1. Submittal shall include electronic scans of all submitted physical documents.
 - 2. Contractor may elect to maintain electronic as builts. These may be submitted in PDF form in place of scanned hardcopies.
 - 3. Contractor shall do one or the other, not both, to avoid information occurring on one version of the record drawings and not the other version.

1.3 CLOSEOUT SUBMITTALS

- A. A list of closeout requirements is attached at the end of the Division 1 specifications. The intent is to provide an overall summary of requirements and not a comprehensive list. The terms and conditions of the contract require meeting the requirements of the individual specification sections regardless of what is included on the list. Submit the following before requesting final inspection:
 - 1. Submit specific warranties, guarantees, workmanship bonds, final certifications, and similar documents.

2. Submit NPS required forms for occupancy, Fire Sprinkler/Alarm acceptance, and any other similar forms or certificates.
3. Submit Project Record Documents and operation and maintenance manuals and similar final record information.
4. Environmental Record Documents: As specified as follows:
 - a. IAQ Management Plan: As specified in Section 01 57 19.11 "Indoor Air Quality (IAQ) Management".
 - b. Product Data for filtration media: As specified in Section 01 57 19.11 "Indoor Air Quality (IAQ) Management".
 - c. Moisture Control inspections and reports: As specified in Section 01 57 19.11 "Indoor Air Quality (IAQ) Management".
 - d. MSDS Data: As specified in Section 01 57 19.11 "Indoor Air Quality (IAQ) Management" and Section 01 81 13 "Sustainable Design Requirements".
 - e. Chain-of-Custody Data: As specified in Section 01 81 13 "Sustainable Design Requirements".
 - f. Final Summary Of Solid Waste Disposal And Diversion: As specified in Section 01 74 19 "Construction Waste Management".
 - g. Commissioning Report: As specified in Section 01 91 14 "Total Building Commissioning".
5. Submit a summary of the Project Waste Management Plan worksheet for solid waste disposal and diversion. Include the following information:
 - a. Quantity of Construction and Demolition Waste Sent to Landfill. Quantity may be recorded in lbs, tons, cy compacted or cy uncompacted.
 - b. Quantity of Construction Waste and Demolition Waste salvaged or recycled. Itemize type of waste and include quantity of each. Itemized items may include: asphalt, wood pallets, etc.
 - c. Waste Reduction Calculations: Calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
6. Posted Operating Instructions: As specified in the individual sections. Furnish operating instructions attached to or posted adjacent to equipment. Include wiring diagrams, control diagrams, control sequence, start-up, adjustment, operation, lubrication, shut-down, safety precautions, procedures in the event of equipment failure, and other items of instruction recommended by the manufacturer.
7. Deliver tools, spare parts, extra materials, and similar items to location designated by Contracting Officer. Label with manufacturer's name and model number where applicable.
 - a. Special Tools: One set of special tools required to operate, adjust, dismantle, or repair equipment. Special tools are those not normally found in possession of mechanics or maintenance personnel.
8. Keys and Keying Schedule: Submit all keys including duplicates. Wire all keys for each lock securely together. Tag and plainly mark with lock number, equipment identification, or panel or switch number, and indicate location, such as building and room name or number.
9. Make final changeover of permanent locks and deliver keys to Contracting Officer. Advise Park personnel of changeover in security provisions.
10. Submit approved pre-functional checklists and functional performance testing reports from the commissioning documentation.
 - a. Equipment start-up requires coordination with the commissioning process. Refer to Section 01 91 14 "Total Building Commissioning" Equipment shall not be "temporarily" started for commissioning.
11. Submit test and balance report.

12. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
15. Instruct NPS personnel in operation, adjustment, and maintenance of products, equipment, and systems.

1.4 SUBSTANTIAL COMPLETION AND FINAL INSPECTION

- A. When project, or designated portion of project, is substantially complete, request in writing a final inspection. Upon receipt of written request that project is substantially complete, the Contracting Officer will proceed with inspection within 10 days of receipt of request or will advise the Contractor of items that prevent the project from being designated as substantially complete.
- B. If, following final inspection, the work is determined to be substantially complete, Contracting Officer will prepare a Punch List to be corrected before final acceptance and issue a Letter of Substantial Completion. Contractor shall complete the work described on the Punch List within 30 calendar days, as weather permits. If the Contractor fails to complete the work within this time frame, the Contracting Officer may either replace or correct the work with an appropriate reduction in the contract price or charge for re-inspection costs in accordance with the Inspection of Construction clause of the contract.
- C. If, following final inspection, the work is not determined to be substantially complete; Contracting Officer will notify Contractor in writing. After completing work, Contractor shall request a new final inspection. All re-inspection costs may be charged against the Contractor in accordance with the Inspection of Construction clause of the contract.

1.5 FINAL ACCEPTANCE OF THE WORK

- A. Prior to requesting inspection for verification of completion of all outstanding items:
 1. Complete commissioning requirements of Section 01 91 14 "Total Building Commissioning", unless approved in writing by the Contracting Officer. Exceptions to this are required seasonal and approved deferred testing.
- B. After all deficiencies have been corrected, a Letter of Final Acceptance will be issued.

1.6 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Contracting Officer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. See Section 01 73 40 "Execution" for information on cleaning agents.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - j. Remove labels that are not permanent.
 - k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

- l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - p. Leave Project clean and ready for occupancy.
- C. Pest Control: Make a final inspection and rid Project of rodents, insects, and other pests.
- D. Waste Disposal: Comply with requirements of Division 01 Section 01 74 19 "Construction Waste Management and Disposal."

END OF SECTION 01 77 00 - CLOSEOUT PROCEDURES

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SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 78 23 “Operation and Maintenance Data” includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Manuals, General.
 - 2. Operation and maintenance information for systems, subsystems, and equipment, products, materials and finishes.
- B. See Divisions 02 through 49 Sections for additional operation and maintenance manual requirements for the Work in those Sections.

1.2 SUBMITTALS

- A. Draft Manual: Submit in draft form at least 15 days before final inspection. Contracting Officer will return copy with comments within 15 days of receipt.
 - 1. Format: Submit draft operations and maintenance manuals in PDF electronic file format or in hardcopy format.
 - a. PDF electronic file. Assemble each manual into a composite electronic file. Submit on digital media acceptable to Contracting Officer.
 - b. Hardcopy, submit one copy.
- B. Final Manual: Correct or modify each manual to comply with Contracting Officer’s comments and submit final corrected manual within 15 days of receipt of Contracting Officers comments.
 - 1. Format: Submit final operations and maintenance manuals in PDF electronic file format and hardcopy format.
 - a. PDF electronic file. Assemble manual into a composite electronic file with clearly labelled index/bookmarks. Submit on digital media acceptable to Contracting Officer.
 - b. Hardcopy, submit three copies.
 - c. Hardcopy, submit four copies.

1.3 QUALITY ASSURANCE

- A. Coordinate with Section 01 91 14 “Total Building Commissioning.” The Commissioning Agent shall review the Operation and Maintenance Manuals for systems that were commissioned.

PART 2 - PRODUCTS

2.1 MANUALS, GENERAL

A. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Project Title.
2. Location.
3. Park.
4. Contract Number.
5. Prime Contractors Name and Address.
6. All subcontractors' names and addresses including portions of project completed by each subcontractor.
7. Date of Substantial Completion.

B. Manual Contents:

1. Contractor shall provide both electronic and hard copy versions of the Operations and Maintenance Manuals.
2. Binders: White, commercial quality, hard back, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic window sleeve on front and spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. Cover Sheet: Identify each binder on front and spine, with the project title, location, park, contract number, prime contractor's name and address, and date of substantial completion. Insert cover sheet into clear plastic view pocket on front of binder. Insert sheet into clear plastic view pocket on spine with title "OPERATION AND MAINTENANCE MANUAL," and Project title or name.
 - b. Data: Fill binders to no more than 75 percent of capacity. Punch holes shall not obscure any data.
 - c. Manufacturers' Data: Provide originals for color or copyrighted data. Black and white data may be originals or clean, good quality reproductions. Copies produced by facsimile transmission and sheets with stamps will not be acceptable. Include only sheets that apply to items installed.
 - d. Vendor Furnished As-Built Drawings: Maximum 24-inch by 36-inch sheets with minimum character or lettering size of 1/8 inch. Reduced-size reproductions may be provided instead of full-size drawings if the reproductions are clear and legible. If reduced-size drawings are used, identify as "REDUCED SIZE" and provide graphic scales, if applicable.
 - e. Custom Data: Data supplemented by drawings and schematics necessary to describe systems adequately.
 - f. Schedules: Schedules reflecting final, as-installed conditions.
 - g. Data that is poorly reproduced or in any way illegible will be rejected.
3. Drawings:
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes.
4. PDFs

- a. PDFs shall be clearly organized and labelled. This may be achieved by keeping component PDFs separate and the file name clearly identifying the subject. OR This may be achieved in a single comprehensive PDF that is indexed/bookmarked with clear labelling such that the user may jump to a specific subject with a couple clicks. Contractor shall confirm strategy with Contracting Officer prior to submittal of O&M manual.
- b. Final PDFs shall be submitted on a clearly labeled thumbdrive and directly through an FTP site for park download.

2.2 OPERATION AND MAINTENANCE INFORMATION FOR SYSTEMS AND EQUIPMENT

A. Operation Requirements

1. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.
2. Descriptions: Include the following:
 - a. Product name and model number.
 - b. Manufacturer's name.
 - c. Equipment identification with serial number of each component.
 - d. Equipment function.
 - e. Operating characteristics.
 - f. Limiting conditions.
 - g. Performance curves.
 - h. Engineering data and tests.
 - i. Complete nomenclature and number of replacement parts.
3. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
4. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
5. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

B. Maintenance Requirements for Systems and Equipment

1. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
2. Source Information: For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
3. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:

4. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions, that detail essential maintenance and environmental procedures.
5. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
6. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
7. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
8. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.3 PRODUCT MAINTENANCE INFORMATION

- A. Source Information: For each product, list name, address, and telephone number of installer or supplier and maintenance service agent.
- B. Product Information: Include the following, as applicable:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- C. Environmental Requirements
 1. Identify environmentally preferable products incorporated into the Project. Include: product model; manufacturer's name, address, phone, and website; and local technical representative, if any
 - a. Describe maintenance procedures associated with environmentally preferable materials and systems.
 - b. Material Safety Data Sheets: Include MSDSs as specified.
- D. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 GENERAL

- A. At start of project, begin accumulating operation and maintenance data. Install all data in binders within 30 days after delivery of items. As custom written data and test results are produced, add them to the operation and maintenance data file.
- B. A list of Operation and Maintenance requirements has been attached at the end of Division 01 specifications. The intent is to provide an overall summary of requirements and not a comprehensive list. The terms and conditions of the contract require meeting the requirements of the individual specification sections regardless of what is included on the list.
- C. Keep operation and maintenance data current. Make operation and maintenance binders available to the Contracting Officer for inspection at the time of monthly progress payment requests. If operation and maintenance binders are not current the Contracting Officer may retain an appropriate amount of the progress payment.

3.2 MANUAL PREPARATION

- A. Manual Contents: Including but not limited to:
 - 1. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents.
 - 2. Custom Written Data: For data not in manufacturer's standard literature, provide text, drawings, and schematics specifically applicable to installed systems. Include step-by-step descriptions of operating procedures; identification of individual components and their functions; descriptions of how system components relate to one another and operate together to accomplish a common process or function; and sequence of operation for system control circuits. For seasonally operated systems, provide start-up and shutdown instructions.
 - 3. Vendor Furnished As-Built Drawings: Provide for each electrical and each mechanical control system.
 - a. For each control system, provide control circuit schematic drawings. Identify each wire and terminal block number. Show terminal numbers on all control devices. Show control wires and devices remote from the control panel.
 - b. For each control panel, provide a general arrangement drawing showing location of each control component and terminal block on the panel front and interior. Include a materials list of all panel-mounted control components as well as field-installed control components remote from the panel, identifying components, manufacturer, model number, and initial set points or sensing ranges of devices where applicable.
 - c. For packaged equipment systems, provide general arrangement drawings showing interrelationships of the various items of equipment and components.
 - d. In addition to the control wiring schematic, provide a power wiring schematic drawing showing the power flow to each motor. Identify each power conductor. Show all over-current protection and motor starting devices.

- B. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 79 00 "Demonstration and Training" includes administrative and procedural requirements for instructing NPS personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment, including environmental considerations.
 - 3. Demonstration and training video.
- B. See Divisions 02 through 49 Sections for specific requirements for demonstration and training for products in those Sections.

1.2 GENERAL REQUIREMENTS

- A. A list of System Demonstration and Training requirements is attached at the end of Division 01 specifications. The intent is to provide an overall summary of requirements and not a comprehensive list. The terms and conditions of the contract require meeting the requirements of the individual specification sections regardless of what is included on the list.

1.3 SUBMITTALS

- A. Demonstration and Training Video: Submit two (2) copies of each DVD for all training sessions within seven (7) days of end of each training module.
 - 1. Label each DVD with the date of demonstration or training, the instructor's name

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project.
- B. Instructor Qualifications: A factory-authorized service representative experienced in operation and maintenance procedures and training.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not schedule training program until operation and maintenance data has been reviewed and approved by Contracting Officer.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
- a. Operation and maintenance of Outdoor Variable Refrigerant Flow (CU) Condensing Units
 - b. Operation and maintenance of Indoor Air Conditioning Units (AC)
 - c. Operation and maintenance of Energy Recovery Ventilator (ERV)
 - d. Operation and maintenance of Makeup Air Unit (MAU)
 - e. Operation and maintenance of Electric Duct Heater (EDH)
 - f. Operation and maintenance of Electric Unit Heater (EUH)
1. Environmental Topics
- a. Overview of environmental issues related to the building industry.
 - b. Overview of environmental issues related to the Project.
 - c. Review of site specific procedures and management plans implemented during construction:
 - 1) Regulatory Requirements.
 - 2) Indoor Air Quality (IAQ) Management.
 - 3) Noise & Acoustics Management.
 - 4) Environmental Management.
 - 5) Construction Waste Management.
 - d. Review of site specific procedures and management plans to be implemented during operation and maintenance.
 - 1) Include review of environmentally-related aspects of the Operations and Maintenance Manual.
- B. Training Modules: For each module, include instruction for the following:
1. Basis of System Design, Operational Requirements, and Criteria: Include system and equipment descriptions, operating standards, regulatory requirements, equipment function, operating characteristics, limiting conditions, and performance curves.
 2. Documentation: Review emergency, operations, and maintenance manuals; Project Record Documents; identification systems; warranties and bonds; and maintenance service agreements.
 3. Emergencies: Include instructions on stopping; shutdown instructions; operating instructions for conditions outside normal operating limits; instructions on meaning of warnings, trouble indications, and error messages; and required sequences for electric or electronic systems.
 4. Operations: Include startup, break-in, control, and safety procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; operating procedures for emergencies and equipment failure; and required sequences for electric or electronic systems.

5. Adjustments: Include alignments and checking, noise, vibration, economy, and efficiency adjustments.
6. Troubleshooting: Include diagnostic instructions and test and inspection procedures.
7. Maintenance: Include inspection procedures, types of cleaning agents, methods of cleaning, procedures for preventive and routine maintenance, and instruction on use of special tools.
8. Repairs: Include diagnosis, repair, and disassembly instructions; instructions for identifying parts; and review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 INSTRUCTION

- A. Engage qualified instructors to instruct NPS personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- B. Scheduling: Provide instruction at mutually agreed on times.
 1. Schedule training with NPS through the Contracting Officer with at least seven (7) days advance notice.
 2. Conduct training sessions after the equipment or system has been accepted and turned over to the Government. Coordinate with commissioning requirements.
 3. Individual sections specify the duration of training required. If no duration is listed, provide training of sufficient duration to adequately cover the subjects.

3.2 DEMONSTRATION AND TRAINING VIDEO

- A. General: Record demonstration and training video. Record each training module separately. Include instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
- B. Video Format: Digital Video Disc (DVD).
- C. Video Recording: Record all of the above sessions with high resolution equipment. The instructor's voice shall be clearly audible and understandable on the DVD. Utilize a supplemental microphone worn by the instructor
- D. Narration: Describe scenes on video by dubbing audio narration off-site after video is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 1. DVDs with poor video or audio quality will be rejected and the training recorded again.

END OF SECTION 01 79 00 - DEMONSTRATION AND TRAINING

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SECTION 01 81 13 - SUSTAINABLE DESIGN REQUIREMENTS FOR NON LEED™ PROJECTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 81 13 “Sustainable Design Requirements for Non LEED™ Projects” includes general requirements and procedures for compliance with the Federal Sustainability requirements. This project is not seeking LEED™ certification but shall comply with the applicable Federal Sustainability requirements. These requirements include laws (Executive Orders and regulations), management policies, building codes and standards, Federal directives, and NPS guidelines.
- B. Many of the Federal requirements can be achieved only through intelligent and integrated design of the project and are beyond the control of the Contractor. However, certain requirements relate to the products and procedures used for construction. Therefore, the full cooperation of the Contractor and subcontractors is essential to successful compliance with the Federal requirements.
- C. Contractors shall familiarize themselves with the relevant requirements and provide the necessary information and instruction to all subcontractors and installers.
 - 1. Some requirements involve quantifying percentages by weight; these require careful recordkeeping and reporting by the Contractor.
 - 2. See <http://www.nps.gov/dscw/dssustain.htm> for a list of Federal Sustainability requirements. The applicable Federal Sustainability requirements are also summarized on the project’s NPS Project Sustainability Checklist. Contractor is responsible for providing the necessary information in the “Construction” column of the checklist.
- D. Related Sections:
 - 1. See Divisions 01 through 49 Sections for sustainability requirements specific to the work of each of these Sections.

1.2 DEFINITIONS

- A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
- B. LEED™: Leadership in Energy & Environmental Design. A sustainability rating system developed by the United States Green Building Council.

- C. Rapidly Renewable Materials: Materials made from plants that are typically harvested within a 10-year or shorter cycle. Rapidly renewable materials include products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, or wool.
- D. Recycled Content: The recycled content value of a material assembly shall be determined by weight.
 - 1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
 - 2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.
- E. Biopreferred Products: Commercial or industrial products (other than food or feed) that are composed in whole, or in significant part, of biological products, renewable agricultural materials (including plant, animal, and marine materials), or forestry materials and includes biobased intermediate ingredients or feedstocks.

1.3 FEDERAL SUSTAINABILITY DOCUMENTATION SUBMITTALS

- A. Most of the Federal sustainability documentation submittals are aggregations of submittals already required in relevant technical specifications. They are mentioned here to insure that they are collected and organized together to efficiently document compliance with sustainability requirements.
- B. Provide preliminary submittals to NPS indicating how the following Federal requirements will be met:
 - 1. Recycled Content: List of specified/proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
 - 2. Certified Wood: Product data and/or chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
 - 3. Construction IAQ Management Plan – During Construction:
 - a. Construction indoor-air-quality management plan.
 - b. Product data for temporary filtration media.
 - c. Product data for filtration media used during occupancy.
 - d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
 - 4. Construction IAQ Management Plan – Before Occupancy:

- a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
 - b. Product data for filtration media used during flush-out and during occupancy.
5. Low Emitting Materials – Adhesives and Sealants: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.
 6. Low Emitting Materials – Paints and Coatings: Product data for paints and coatings used inside the weatherproofing system indicating **[chemical composition and]** VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.
 7. Low Emitting Materials - Flooring: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.
 8. Biopreferred Products: Provide a list of all bio-based products used on this project.

PART 2 - PRODUCTS

2.1 RECYCLED CONTENT OF MATERIALS

- A. Recycled Content: Provide building materials with recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 10 percent of cost of materials used for Project.
 1. Cost of pre-consumer recycled content of an item shall be determined by dividing weight of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
 2. Do not include furniture, mechanical and electrical components, and specialty items in the calculation.

2.2 BIOPREFERRED PRODUCTS

- A. Bio-based products found the USDA Biopreferred Products list (<http://www.biopreferred.gov/>) shall be used where applicable on this project.

2.3 LOW-EMITTING MATERIALS

- A. For applications that are inside the weatherproofing system, use adhesives and sealants that comply with the VOC content limits in specification divisions 2-49
- B. For field applications that are inside the weatherproofing system, use paints and coatings that comply with the VOC content limits in specification divisions 2-49
- C. Do not use composite wood or agrifiber products or adhesives that contain urea-formaldehyde resin.

PART 3 - EXECUTION

3.1 MEASUREMENT AND VERIFICATION

- A. Coordinate with Divisions 2-49 for project requirements regarding the installation of building level metering equipment to measure energy, water, and electric usage.

3.2 INDOOR-AIR-QUALITY MANAGEMENT

- A. Coordinate with Section 01 57 19.11 “Indoor Air Quality Management” for managing indoor air quality during construction and prior to occupancy.

END OF SECTION 01 81 13 - SUSTAINABLE DESIGN REQUIREMENTS FOR NON LEED™ PROJECTS

SECTION 01 91 14 – TOTAL BUILDING COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 01 91 14 “Total Building Commissioning” Includes:
1. General requirements for coordinating and scheduling commissioning.
 2. Commissioning meetings.
 3. Commissioning reports.
 4. Use of test equipment, instrumentation, and tools for commissioning.
 5. Construction checklists, including, but not limited to, installation checks, startup, and performance tests.
 6. Commissioning tests.
 7. Adjusting, verifying, and documenting identified systems and assemblies.
- B. The work included under this section includes a complete and thorough investigation of equipment and systems indicated in Part 3 of this section. In order to ensure proper installation and operation of all components and systems the contractor shall perform commissioning as described herein to accomplish the tasks, and goals of commissioning. Systems to be evaluated include but are not limited to the following:
1. HVAC components and equipment.
 2. HVAC system: interaction of cooling, heating, and comfort delivery systems.
 3. Lighting Control System
 4. Building Envelope (walls, roof, windows, infiltration, etc.)
 5. Life Safety Systems (Fire Alarm & Suppression)
 6. Access Control/ Security Systems
 7. Lightning Protection (Only if Bid Option #8 is approved)
- C. Building commissioning activities and documentation are described in the following reference material, the ,U.S. Green Building Council (USGBC) LEED™ rating program, ASHRAE Guideline 0-2005, The Commissioning Process, and National Institute of Building Sciences (NIBS) Guidelines.
- D. The NPS personnel, Green Consultant, and Architect/Engineer, are not responsible for construction means, methods, job safety, or management function related to commissioning on the job site.
- E. Related Sections:
1. Section 01 31 00 “Project Management & Coordination”
 2. Section 01 33 23 “Submittal Procedures”
 3. Section 01 40 00 “Quality Requirements”
 4. Section 01 57 19.11 “Indoor Air Quality (IAQ) Management”
 5. Section 01 57 19.12 “Noise & Acoustics Management”
 6. Section 01 78 23 “Operation & Maintenance Data”

7. Section 01 81 13 “Sustainable Design Requirements”
8. Section 01 77 00 “Closeout Procedures”
9. Section 01 79 00 “Demonstration and Training”

1.2 DEFINITIONS

- A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity.
- B. Basis-of-Design Document: A document prepared by the Designer that records concepts, calculations, decisions, and product selections used to comply with Contracting Officer’s Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.
- C. Total Building Commissioning (TBC): A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Contracting Officer’s Project Requirements. The requirements specified here are limited to the construction phase commissioning activities.
- D. Construction Checklist: A form used by the contractor to verify that appropriate components are on site, ready for installation, correctly installed and functional.
- E. Contractor’s Commissioning Representative: (CCxR) The Contractor’s designated individual to coordinate, manage, and execute the commissioning processes of the contracting organizations.
- F. Commissioning Plan (CCxP): A plan that provides the structure, schedule and coordination planning for the commissioning process proposed specifically for this project. The CCxP includes Personnel, activities, and a description of the Infrastructure, and a list of all instruments and logging devices that will be used during Commissioning.
- G. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents, does not perform properly or is not complying with the Basis of Design.
- H. Functional Performance Test (FPT): Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system’s sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional performance testing, in the commissioning sense of the word. TAB’s primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The CCxR develops the sequentially written functional test procedure forms, and oversees and documents the actual testing, which is performed by the installing contractor or vendor. The CCxR creates worksheets from these forms which include procedures required to accommodate actual equipment, means and methods used in the project. Functional Performance Tests are performed after pre-functional checklists and startup is complete.

- I. Manual Test: Using hand-held instruments, control system readouts or direct observation to verify performance (contrasted to analyzing electronically monitored data taken over time to make the “observation”).
- J. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.
- K. Contracting Officer’s Project Requirements: A document originated by the Designer that details the functional requirements of a project and the expectations of how it will be used and operated, including project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This document is updated, with input from the CO as required as the project is finished.
- L. Pre-functional Checklist: A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels ok, labels affixed, gages in place, sensors calibrated, etc.). However, some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system). The word “pre-functional” refers to “before” functional testing. Pre-functional checklists augment and are combined with the equipment manufacturer’s start-up checklist.
- M. Seasonal Performance Tests: Functional Performance Tests that are deferred until the system(s) will experience seasonal conditions closer to their design conditions.
- N. Systems Manual: A system focused composite document that includes the operational manual, maintenance manual, and additional information of use to the Government during the Occupancy and Operation Phase.

1.3 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action.
 - 1. CCxR, -The Contractor’s Commissioning Representative. The CCxR shall be approved by the Contracting Officer (CO) and satisfy as many of the following requirements as possible:
 - a. Certified in Commissioning by a nationally accredited organization (i.e. Associated Air Balance Council (AABC), Association of Energy Engineers (AEE), Building Commissioning Association (BCA), and National Environmental Balancing Bureau (NEBB)).
 - b. Acted as the principal Commissioning Authority where the total building commissioning approach (including building envelope) was used for at least three projects of comparable size, type, and scope.
 - c. Technical training in Mechanical, Electrical, and/or fire protection engineering
 - d. Past commissioning experience.
 - e. Knowledge of national codes.
 - f. Leadership in Energy and Environmental Design (LEED) Accredited Professional.
 - g. Experience in energy-efficient design and control strategy optimization.

- h. Specific experience with specialty systems relative to the particular facility type (i.e. Federal blast and progressive collapse requirements, security systems, etc.)
2. CQC Supervisor – Contractor’s quality control supervisor
3. Other Representatives - May include Project superintendents, installers, suppliers, and specialists.

B. Members Appointed by Contracting Officer (CO):

1. Representatives of the facility user and operation and maintenance personnel.
2. Architect and engineering design professionals.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Perform commissioning tests, as required by the technical specifications. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
2. Record and resolve commissioning issues.
3. Attend commissioning team meetings held on a biweekly basis.
4. Integrate and coordinate commissioning process activities with the overall project schedule.
5. Review the Construction Checklist attached at the end of this specification section.
6. Complete electronic construction checklists as contract work is completed and provide to the CO on a weekly basis.
7. Complete commissioning process test procedures.
8. Provide maintenance orientation and inspection for systems, assemblies, equipment, and components based on contract requirements.
9. Provide Commissioning Plan and documentation for final commissioning documentation.
10. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.5 COMMISSIONING DOCUMENTATION

A. Provide the following information:

1. Review of systems manual, submittals, documents, and other commissioning reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Commissioning Plan including Process activities and schedule for completing construction checklists and manufacturer's pre-start and startup checklists for systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of readiness certifying that systems, subsystems, equipment, and associated controls are ready for testing.
5. Test and inspection reports and certificates.

6. Corrective action documents.
7. Testing, adjusting, and balancing reports.

1.6 SUBMITTALS

- A. Two-week look-ahead schedules: A schedule showing the next two weeks of commissioning related construction activity to include completion dates for each element of commissioning documentation for each major system or subsystem as identified in 1.1.B.
- B. Certificates of readiness.
- C. Contractor's Commissioning Representative Qualifications.
- D. Commissioning Plan: Submit within 30 calendar days of authorization to proceed.
 1. Update as necessary during the work to reflect the progress on the components and systems.
- E. Pre functional checklists.
- F. Contracting Officer's project requirements.
- G. Functional performance test forms: Submit minimum 30 calendar days prior to testing
- H. List of test instrumentation, equipment, and monitoring devices. Include the following information:
 1. Make, model, serial number, and application for each instrument, equipment, and monitoring device.
 2. Brief description of intended use.
 3. Calibration record showing the following:
 - a. Calibration agency, including name and contact information.
 - b. Last date of calibration.
 - c. Range of values for which calibration is valid.
 - d. Certification of accuracy.
 - e. N.I.S.T. traceability certification for calibration equipment.
 - f. Due date of the next calibration.
- I. Deficiency Report and Resolution Record: Document items of non-compliance in materials, installation or operation. Document the results from start-up/pre-functional checklists, functional performance testing, and short-term diagnostic monitoring. Include details of the components or systems found to be non-compliant with the drawings and specifications. Identify adjustments and alterations required to correct the system operation, and identify who is responsible for making the corrective changes.
 1. Update as necessary during the work to reflect the progress on the components and systems. Submit updated versions monthly.
- J. Closeout Documentation

1. Closeout documents for commissioned equipment and systems shall be submitted prior to the functional performance testing. These include, but are not necessarily limited to:
 - a. Record Documents and Drawings
 - b. Start-up certificates for all commissioned equipment with start-up requirements.
 - c. Systems Manual
 - d. Include TAB, startup, and Control System check-out reports.
 - e. Closeout documents required by Section 01 78 23 "Operation and Maintenance".
 - f. Other documents required by Section(s) 33 34 00, 46 07 13.
2. O&M Submittals (refer to requirements of technical specifications):
 - a. Training plan: Training plan shall include the following for each training session:
 - 1) Dates, start and finish times, and locations;
 - 2) Outline of the information to be presented;
 - 3) Names and qualifications of the presenters;
 - 4) List of texts and other materials required to support training.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Instrumentation shall meet the following standards:
 1. Be of sufficient quality and accuracy to test and measure system performance within the tolerances required to determine adequate performance.
 2. Be calibrated on the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument being used.
 3. Be maintained in good repair and operation condition throughout the duration of use on this project.
- B. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Contractor for the equipment being tested.
- C. All required commissioning equipment (sensors, transducers, data loggers, etc.) not integral to the systems or equipment installed will be provided by the Contractors Commissioning Representative, and shall not become the property of the Government.

2.2 PRE FUNCTIONAL CHECKLIST:

- A. Prepare pre functional checklists for all equipment and systems to be commissioned.
- B. The pre functional checklists shall be complementary to the Commissioning Plan and Commissioning Schedule

2.3 FUNCTIONAL TEST PROCEDURE FORMS: Prepare functional test procedure forms for each piece of equipment and each system to be commissioned.

2.4 FUNCTIONAL PERFORMANCE WORKSHEETS:

- A. Prepare Functional Performance worksheets, consisting of the test procedures and expected results of the testing.

2.5 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:

- 1. Bind report in three-ring binders.
- 2. Label the front cover and spine of each binder with the report title, volume number, project name, Contractor's name, and date of report.
- 3. Record report on compact disk.
- 4. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report:

- 1. Include a table of contents and an index to each test.
- 2. Include major tabs for each Specification Section.
- 3. Include minor tabs for each test.
- 4. Within each minor tab, include the following:
 - a. Test specification.
 - b. Pre-startup reports.
 - c. Approved test procedures.
 - d. Test data forms, completed and signed.
 - e. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS

- A. The following activities outline the general commissioning tasks (requiring development, execution, etc.) and order in which they occur. Specific Commissioning requirements are found in the technical specification Sections 25 05 93, 26 08 00.

- 1. Commissioning Scoping Meeting.
- 2. Finalize Contracting Officer's Project Requirements.
- 3. Commissioning Plan.
- 4. Prepare pre functional checklists.

5. Prepare functional performance worksheets.
6. Perform Start-Up/Pre-Functional Checks in accordance with manufacturer's recommendations and pre-functional checklists.
7. Functional Performance Testing in accordance with functional performance worksheets.
8. Deficiency Report and Resolution Record.
9. Operation and Maintenance Documentation.
10. Operations and Maintenance Training.
11. Deferred testing

3.2 TOTAL BUILDING COMMISSIONING REQUIREMENTS (TBC)

- A. TBC during the construction, acceptance, and warranty phases is intended to achieve the following specific objectives:
1. Verify that the systems and equipment meet the Project Requirements
 2. Verify that equipment is what was submitted and approved.
 3. Verify and document that equipment is installed and started per manufacturer's recommendations, industry accepted minimum standards, and the Contract Documents.
 4. Verify and document that equipment and systems receive complete operational checkout by installing contractors.
 5. Verify and document equipment capacity and system efficiency.
 6. Verify the performance of the building envelope. Document testing and conformance to the Contract Documents.
 7. Verify the completeness of operations and maintenance materials.
 8. Ensure that the Governments operating personnel are adequately trained on the operation and maintenance of building equipment.

3.3 COMMISSIONING SCOPING MEETING

- A. Commissioning Scoping Meeting:
1. Schedule, coordinate, and facilitate a scoping meeting.
 2. Review each building system to be commissioned, including its intended operation, commissioning requirements, and completion and start-up schedules.
 3. Establish the scope of work, tasks, schedules, deliverables, and responsibilities for implementation of the Commissioning Plan.
 4. Attendance: Commissioning Team members.

3.4 COMMISSIONING PLAN

- A. Commissioning Plan: Develop a commissioning plan to identify how commissioning activities will be integrated into general construction and trade activities. The **commissioning** plan shall identify how commissioning responsibilities are distributed. The intent of this plan is to evoke questions, expose issues, and resolve issues with input from the entire commissioning team early in construction.
1. Identify who will be responsible for producing the various procedures, reports, CO notifications and forms.

2. Include the commissioning tasks and activities in the overall project schedule. Tag individual activities so they can be filtered at a later date.
3. List and describe each test/acceptance procedure, including the acceptance criteria.

3.5 START-UP/PRE-FUNCTIONAL CHECKLISTS

- A. Start-Up/Pre-Functional Checklists: Complete pre-functional checklists prior to start up. Checklist shall help verify that the systems are complete and operational, so that the functional performance testing can be scheduled.
 1. Verify equipment installed is what was approved on the Submittal.
 2. Manufacturer's start-up checklists and other technical documentation guidelines may be used as the basis for pre-functional checklists.

3.6 FUNCTIONAL PERFORMANCE TESTING

- A. Functional Performance Testing: Test procedures fully describe system configuration and steps required for each test.
 1. Test Methods: Functional performance testing and verification may be achieved by direct manipulation of system inputs (i.e. heating or cooling sensors), manipulation of system inputs with the building automation system (i.e. software override of sensor inputs), trend logs of system inputs and outputs using the building automation system, or short-term monitoring of system inputs and outputs using stand alone data loggers. A combination of methods may be required to completely test the complete sequence of operations. The CCxR shall determine which method or combination of methods is most appropriate.
 2. Setup: Each test procedure shall be performed under conditions that simulate normal operating conditions as closely as possible. Where equipment requires integral safety devices to stop/prevent equipment operation unless minimum safety standards or conditions are met, functional performance test procedures shall demonstrate the actual performance of safety shutoffs in real or closely-simulated conditions of failure.
 3. Sampling: Multiple identical pieces of non-life-safety or non-critical equipment may be functionally tested using a sampling strategy. If, after three attempts at testing the specified sample percentage, failures are still present, then all remaining units shall be tested at the Contractors' expense.
- B. Prepare functional performance test procedure forms to accommodate actual installed equipment and systems.
- C. Coordinate, execute and record the results of the functional performance testing.
 1. Coordinate retesting as necessary until satisfactory performance is verified.
 2. Verify the intended operation of individual components and system interactions under various conditions and modes of operation.

3.7 DEFICIENCY REPORT AND RESOLUTION RECORD

- A. Deficiency Report and Resolution Record: Document items of non-compliance in materials, installation or operation.
- B. Non-Conformance. Non-conformance and deficiencies observed shall be addressed immediately. Notify responsible parties and provide recommended actions to correct deficiencies.
 - 1. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CCxR. In such cases the deficiency and resolution shall be documented on the procedure form.
 - 2. For identified deficiencies:
 - a. If there is no dispute on the deficiency and the responsibility to correct it:
 - 1) The CCxR documents the deficiency and the adjustments or alterations required to correct it. The contractor corrects the deficiency and notifies the CCxR that the equipment is ready to be retested.
 - 2) The CCxR reschedules the test and the test is repeated until satisfactory performance is achieved.
 - b. If there is a dispute about a deficiency or who is responsible:
 - 1) The deficiency is documented CCxR on the non-compliance form.
 - 2) Resolutions are made at the lowest management level possible. Additional parties are brought into the discussions as needed. Contractor shall have responsibility for resolving construction deficiencies. If a design revision is deemed necessary and approved by the CO, Architect/Engineer shall have responsibility for providing design revision. The CCxR documents the resolution process.
 - 3) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency and notifies the CCxR that the equipment is ready to be retested. The CCxR reschedules the test and the test is repeated until satisfactory performance is achieved.
 - 3. Cost of Retesting: Costs for retesting shall be charged to the Contractor.

3.8 OPERATIONS AND MAINTENANCE TRAINING

- A. Training: Develop a Training Plan. Coordinate and execute the training programs with the CxA.
 - 1. Stress and enhance the importance of system interactions, troubleshooting, and long-term preventive maintenance and operation programs.

3.9 DEFERRED TESTING

- A. Unforeseen Deferred Tests: If a test cannot be completed due to the building structure, required occupancy condition, or other deficiency, the functional testing may be delayed upon

recommendation of the CCxR and the approval of the Contracting Officer. These tests are conducted in the same manner as the seasonal tests, as soon as possible.

B. Seasonal Testing;

1. Schedule, coordinate, execute, and document additional testing for seasonal variation in operations and control strategies during the appropriate season to verify performance of the HVAC system and controls. Complete testing during the warranty period to fully test all sequences of operation.
2. Update O&M manuals and Project Record Drawings as necessary due to the testing.

3.10 EQUIPMENT & SYSTEM SCHEDULE

A. Commissioned Equipment and Systems List: The following is a list of systems and equipment to be commissioned organized by system. It also includes the percentage of each category that will undergo testing. The intent is to provide an overall summary of commissioned equipment and systems, and not a comprehensive list. Refer to applicable specification sections for more information.

COMMISSIONED EQUIPMENT AND SYSTEMS LIST			
SYSTEM	EQUIPMENT	CC	FPT
Main Building Ventilation	Energy Recovery Ventilation (ERV)		
Main Building Ventilation	Indoor Air Conditioning Units (ACs)		
Main Building Ventilation	Intake Louver (L-1)		
Main Building Ventilation	Exhaust Louver (L-2)		
Main Building Conditioning	Outdoor VRF Condensing Unit (CU)		
Kiosk Ventilation	Make-up Air Units (MAU)		
Kiosk Conditioning	Electric Duct Heater (EDH)		
Kiosk Conditioning	Indoor Air Conditioning Unit (AC)		
Kiosk Conditioning	Outdoor VRF Condensing Unit (CU)		
Freeze Protection	Electric Unit Heater (EUH)		
Lighting Controls	Occupancy and Vacancy Sensors (OS1, OSW1, RVS1, RDW2, VSW1)		
Fire Alarm System	FACP, FAA, Smoke Detectors, Horn/Strobe Devices.		
Security System	Motion Detectors, Cameras, Door Contacts, Headend Equipment, Card Readers, Keypads		

END OF SECTION 01 91 14 – TOTAL BUILDING COMMISSIONING

SECTION 02 41 13 - SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Stone Features: Removal or disassembly of CCC stone curb, CCC stone culvert headwalls and CCC stone steps and salvage of stone for reuse and reinstall.
 2. Removal of trash bins and flag pole.
 3. Removal and salvaging wood bollards.
 4. Removal and salvaging signs.
 5. Removal and reinstalling landscape boulders and map return.
 6. Removal and reinstalling felled logs.
 7. Removal of existing culverts.
 8. Protection of items identified to remain.
- B. Related Sections include the following:
1. Section 01 11 00 – Summary of Work
 2. Section 01 32 33 – Photographic Documentation
 3. Section 01 35 91 – Historic Preservation Treatment Procedures
 4. Section 01 57 13 – Temporary Storm Water Pollution Prevention
 5. Section 01 74 19 – Construction Waste Management
 6. Section 02 41 00 – Site Demolition
 7. Section 02 41 00 – Building Demolition
 8. Section 02 41 91 – Selective Historic Demolition
 9. Section 31 10 00 – Site Clearing
 10. Section 31 20 00 – Earth Moving

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction, remove and legally dispose of items unless indicated to be removed and salvaged, reused, reinstalled, or to remain on Park property.
- B. Deconstruction: Disassembly of buildings or features for purpose of recovering materials.
- C. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to the Park. Items indicated to be removed and salvaged shall remain on the Park property. Remove, clean, and pack or crate items to protect against damage. Stockpile items at a location approved of by the CO.
- D. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated. Clean, service, and otherwise prepare items for reuse; store and protect against damage. Reinstall items in locations indicated in the plans and specifications or as directed by the CO.
- E. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Protect items identified to remain against damage and soiling during demolition.

When permitted by the CO, items may be removed to a suitable, protected storage location during demolition and then cleaned and reinstalled in their original locations.

1.3 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain on the Park property, demolished materials shall become the Contractor's property and shall be removed and legally disposed of at the Contractor's expense.

1.4 SUBMITTALS

- A. Shop Drawings with Schedule:
 - 1. Identify items and materials to be salvaged and methods for sorting and identification of materials for reuse and reinstall.
 - 2. Identify procedures for disassembly, sorting, storage, and numbering for reinstall.
 - 3. Identify materials to be recycled.
 - 4. Identify materials to be salvaged for reuse on site and off site.
 - 5. Provide shop drawings as noted on the Drawings.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with safety requirements for demolition, ANSI A10.6-90.
- B. Contractor shall be responsible for repair/replacement of undocumented damage.
- C. Handle waste materials as specified in Section 01 74 19 Construction Waste Management and Disposal.

1.6 PROJECT/SITE CONDITIONS

- A. Occupancy:
 - 1. Sites where features are to be demolished shall be vacated and use discontinued prior to start of work.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by the Park as far as practical.
 - 1. Before selective demolition, the Park will remove the following items: none.
 - 2. The Park assumes no responsibility for actual condition of items or structures to be demolished, salvaged, or reused.
- D. Safety:
 - 1. Ensure safety of persons in demolition area.
 - 2. Provide temporary barricades as required.
 - 3. Provide adequate fire protection.
 - 4. Keep clear of hazardous substances and debris.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

- G. Notify Contracting Officer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

1.6 SCHEDULING

- A. Notify the Contracting Officer 48 hours prior to beginning demolition work.
- B. Complete demolition that might damage new construction before starting new work.
- C. Contractor is responsible for verifying locations of existing utilities.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, preconstruction recordings and templates.
 - 1. Comply with requirements specified in Section 01 32 33 Photographic Documentation.

3.2 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, trails, and other adjacent occupied and used facilities.
 - 1. Comply with requirements for access and protection specified in Section 01 50 00 Temporary Facilities and Controls.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings, sites and facilities to remain.

- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.3 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - 2. Cut or drill to avoid marring existing finished surfaces to remain.
 - 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 - 4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting slopes, pavements or adjacent construction to remain.
 - 5. Dispose of demolished items and materials promptly
- B. Reuse of Features: Project has been designed to reuse materials as follows. Do not demolish features beyond what is indicated on Drawings without CO's approval.
 - 1. Salvaged stone from CCC stone curb, CCC stone culvert headwalls, and CCC stone steps
- C. Removed and Salvaged Items: wood bollards and signs
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to the Government.
 - 4. Transport items to the Government's storage area as indicated on Drawings or in Specifications.
 - 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items: boulders, felled logs and map return
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Contracting Officer, items may be removed to

a suitable, protected storage location during selective demolition and reinstalled in identified locations after selective demolition operations are complete.

3.4 DECONSTRUCTION.

- A. Disassemble stone walls, stone steps and stone features as indicated on Drawings. Identify items for disassembly to be removed for recycling or reuse.
- B. Salvage stone for reuse and for rebuild of stone walls as indicated on Drawings.
 - 1. Materials scheduled for reuse on site include:
 - a. Stone from Stone Walls for reuse and rebuild.
 - b. Stone Steps for reuse.
 - 2. Materials scheduled for reuse and recycling off site: As specified in Section 01 74 19 Construction Waste Management.

3.5 PREPARATION

- A. Provide, erect, and maintain temporary barriers and security devices.
- B. Protect existing materials, features and spaces which are not to be demolished.
- C. Protect existing items which are not indicated to be removed.
- D. Coordinate proposed demolition methods and operations with Contracting Officer prior to start of demolition.
- E. Coordinate with Contracting Officer for shut-off, capping, and continuation of utility services as required.
- F. Install erosion and sediment control measures prior to demolition.
- G. Conduct demolition operations and remove debris to ensure minimum interference with roads, trails, and access.
 - 1. Do not close or obstruct roads within the project area without permission from the CO. Provide alternate routes around closed or obstructed traffic ways.
- H. Conduct demolition operations to prevent injury to people and damage to facilities to remain. Ensure safe passage of people around demolition area.
 - 1. Erect temporary protection where required by Contracting Officer.
 - 2. Protect existing improvements, appurtenances, and landscaping to remain.
 - 3. Erect protective fencing around drip line of individual trees or around perimeter drip line of groups of trees to remain according to requirements specified in Section 31 10 00 Site Clearing and Section 32 40 00 Tree Protection.
 - 4. A vertical sawcut shall be made between any existing pavement that is to remain and the portion to be removed. Where sawcutting is required, the sawcut shall be a minimum of 3 inches deep. When the existing pavement is more than 3 inches thick, the portion below 3 inches may be broken after the sawcut is made.

3.6 POLLUTION CONTROLS

- A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.
 - 1. Do not create hazardous or objectionable conditions, such as ice, flooding, and pollution, when using water.
 - 2. Contractor shall be responsible for ensuring special precautions are undertaken during sawcutting operations. No concrete (asphalt or cement) or concrete by-products are to be discharged into any surface waters. Sawcutting operations will increase the pH of water, therefore filtering is not acceptable.
- B. Remove and transport debris in a manner that will prevent spillage on site improvements and roads.

3.7 REMOVAL

- A. Methods may be revised by Contracting Officer as necessary.
- B. Take every precaution to prevent damage to existing structures, features and surrounding areas.
- C. No flame cutting, vibrating equipment, or explosives will be permitted.
- D. Should accidental damage occur, promptly repair damaged areas to satisfaction of Contracting Officer at no additional expense to the Government.
- E. As previously inaccessible areas are exposed, it may be necessary to halt work temporarily for site or architectural or archeological investigation.
- F. When possible, Contractor shall work elsewhere on project while investigations are conducted.

3.8 DEMOLITION

- A. Filling Below-Grade Areas: Completely fill below-grade areas and voids resulting from demolition of existing facilities shown on Drawings with soil materials according to requirements specified in Section 31 20 00 – Earth Moving.
- B. Damages: Promptly repair damage to adjacent facilities caused by demolition operations.
- C. Do not remove existing culverts until time when new culverts will be installed.

3.9 SALVAGE

- A. Items to be Salvaged and Reused: Stone from Stone Walls, Stone Curbs and Stone Steps.
- B. Carefully clean and store materials and items to be salvaged or reused.
- C. Items to be salvaged or reused shall be stored on-site where directed by Contracting Officer.

3.10 RESTORATION

- A. Repair adjacent surfaces damaged or soiled by demolition work.
- B. Restore utility services to normal operation.
- C. Remove equipment, temporary protection and barriers, and debris and rubbish.
- D. Dispose of unsalvageable materials.

3.11 CLEANING

- A. Remove demolished materials from site as work progresses.
- B. Leave areas of work in clean condition.
- C. Contractor shall repair existing or new work which is not to be removed and that is damaged due to Contractor's operations. Repair shall be by, and at expense, of Contractor.

3.12 SIGNS

- A. Remove existing signs and sign posts as indicated on Drawings.
- B. Remove and salvage existing signs as indicated on Drawings.
 - 1. NPS Monument Arrowhead Sign.
- C. Provide salvaged signs to the Park.

3.13 DISPOSAL AND RECYCLING OF DEMOLISHED MATERIALS

- A. Promptly dispose of or recycle demolished materials: If recycling requires additional time to accomplish, provide for orderly storage of materials. Comply with the waste management plan.
- B. Transport demolished materials off the Park property and legally dispose of or recycle material.
- C. Demolished treated wood shall be disposed of at a construction and demolition landfill and not as land clearing debris.

END OF SECTION 02 41 13

SECTION 02 41 16 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of buildings.
2. Removing below-grade construction.
3. Disconnecting, capping or sealing, and site utilities.
4. Salvaging items for reuse by Government.
5. Salvage of historic headwalls, steps, and curbs shall be conducted with the guidance provided by Section 01 35 91 Historic Preservation Treatment Procedures.

B. Section notes:

1. Refer to Appendix C: Hazardous Materials Assessment Report For Rocky Mountain National Park, Fall River Entrance Station, Estes Park, Colorado, by Landmark Environmental, Inc. dated February 23, 2022.
2. Refer to Division 2 sections listed below for the handling, abatement, and mitigation of hazardous materials found in the existing buildings.

C. Related Requirements:

1. Section 01 10 00 "Summary of Work" for park onsite construction limitations.
2. Section 01 32 33 "Photographic Documentation" for preconstruction photographs taken before building demolition.
3. Section 01 35 13 "Archeological and Historical Resource Protection for protective measures to be taken for protection of cultural resources.
4. Section 01 35 91 "Historic Preservation Treatment Procedures" for removal guidance for historic headwalls, steps, and curbs.
5. Section 01 50 00 "Temporary Facilities and Controls" for use of premises and staging.
6. Section 02 41 13 "Selective Site Demolition" for partial demolition of buildings, structures, and site improvements.
7. Section 02 81 01 "Offsite Transportation and Disposal" for compliant removal procedures for hazardous materials off the project site.
8. Section 02 82 13 "Asbestos Abatement" for compliant removal of asbestos containing materials.
9. Section 02 84 16 "Handling of Other Regulated Materials" for compliant removal of other hazardous materials.
10. Section 02 83 13 "Removal and Disposal of Material Containing Lead" for compliant removal of materials containing lead.
11. Section 31 10 00 "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.

1.2 SALVAGED ITEMS

A. Contractor shall carefully salvage the following prior to start of demolition:

1. Old green safe that is within the wall cupboard in the current office. To be salvaged and placed in a corner of the storage room in the new building.
2. If it has not already been salvaged, carefully salvage the web cam mounted to the exterior of the building/kiosk. To be safely stored for reinstallation.

- B. See also Salvaged Items in Section 02 41 13 "Selective Site Demolition."

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Government ready for reuse or store until ready for reinstallation. Include fasteners or brackets needed for reattachment elsewhere.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Items noted for salvage for reinstallation or return to Government are property of the Government.
 - 1. Carefully salvage in a manner to prevent damage and store safely from damage until return to Government.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site .
 - 1. Inspect and discuss condition of construction to be demolished.
 - 2. Review structural load limitations of existing structures.
 - 3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review and finalize protection requirements.
 - 5. Review procedures for noise control .
 - 6. Review procedures for protection of adjacent buildings.
 - 7. Review items to be salvaged and returned to Government.

1.6 INFORMATIONAL SUBMITTALS

- A. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 01 32 33 "Photographic Documentation." Submit before the Work begins.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

1.9 FIELD CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Government as far as practical.
 - 1. Before building demolition, Government will remove the following items:

- a. Furniture and equipment .
 - b. Personal belongings and documents
- C. Hazardous Materials: Present in buildings and structures to be demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
- 1. Refer to Hazardous Material Report (Appendix C) for identification of hazardous materials and measures to be taken to abate and/or remediate them prior to demolition.
 - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials without an abatement subcontractor.
- D. On-site storage or sale of removed items or materials is not permitted.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

2.2 SOIL MATERIALS

- A. Satisfactory Soils: Comply with requirements in Section 31 20 00 "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped in site demolition before starting structure demolition operations.
- B. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.
- C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- D. Inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

- A. Salvaged Items: Comply with the following:
 - 1. Store items in a secure area until delivery to Contracting Officer.
 - 2. Transport items to storage area designated by Contracting Officer .
 - 3. Protect items from damage during transport and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Utilities to Be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.
 - 1. Arrange to shut off utilities with utility companies.
 - 2. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

- A. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of demolition.
- B. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.
- C. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL

- A. General: Demolish indicated buildings completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
 - 2. Maintain fire watch as described in Section 01 50 00 Temporary Facilities and Controls after flame-cutting operations.
 - 3. Maintain adequate ventilation when using cutting torches.
 - 4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with highway adjacent to facilities.
 - 1. Provide traffic control as described in Section 01 50 00 Temporary Facilities and Controls to ensure highway remains open with temporary closures as approved by Contracting Officer per language within that Section.
 - 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- C. Explosives: Use of explosives is not permitted.

3.6 DEMOLITION BY MECHANICAL MEANS

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- C. Salvage: Items to be removed and salvaged are indicated below:
 - 1. Green safe - see 1.2 for description .
- D. Below-Grade Construction: Demolish foundation walls and other below-grade construction.
 - 1. Remove below-grade construction, including foundation walls, and footings completely .
- E. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 5 feet of footprint indicated for new construction. Abandon utilities outside this area.
 - 1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Section 31 20 00 "Earth Moving."

3.7 SITE RESTORATION

- A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.
- B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Section 31 20 00 "Earth Moving."
- C. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.8 REPAIRS

- A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 01 74 19 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.

3.10 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.
 - 1. Clean roadways of debris caused by debris transport.

END OF SECTION 02 41 16

SECTION 02 81 01 – OFFSITE TRANSPORTATION AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for offsite transportation and disposal of wastes generated during the demolition of the Fall River Entrance Station buildings at Rocky Mountain National Park (ROMO) in Estes Park, Larimer County, Colorado (Project Site).
- B. The Contractor will be responsible for sampling, analysis, and characterization of waste materials to be shipped offsite for disposal or recycling as required by the Treatment Storage and/or Disposal Facility.
- C. It will be the Contractor's sole responsibility to obtain temporary U.S. Environmental Protection Agency (EPA) ID number(s) on behalf of the National Park Service (NPS) for hazardous waste materials generated and removed from the Project Site (s) during the execution of this Project. The Contracting Officer will identify appropriate NPS individuals to sign the required paperwork as the generator signatory for the Project.
- D. Offsite recycling and disposal facilities will be approved by the Contracting Officer prior to offsite transportation of materials.
- E. Transportation of materials will comply with legal load restrictions of the U.S. Department of Transportation (DOT) and the Colorado Department of Transportation (CDOT).

1.2 RELATED SPECIFICATIONS

- A. Section 01 74 19: Construction Waste Management and Disposal
- B. Section 02 82 13: Asbestos Abatement
- C. Section 02 83 13: Removal and Disposal of Material Containing Lead
- D. Section 02 84 16: Handling of Light Ballasts and Lamps and Mercury-Containing Devices

1.3 SUBMITTALS

- A. The Contractor will include as a component of the Waste Management Plan (described in Section 01 74 19 "Construction Waste Management and Disposal") a description of planned means and methods for transporting and disposing of all waste materials removed or generated during the Project.

- B. Permit profile of the Treatment Storage and/or Disposal Facility.
- C. The Contractor will provide an original and/or copies of all Bills of Lading and Manifests for all transported waste material loads from the Project Site with all required generator, transporter, and waste disposal facility receipt/transfer signatures included. These documents will be provided to the Contracting Officer at a minimum on a weekly basis and be accompanied by a detailed electronic waste tracking sheet. The waste tracking sheet will be cumulative and updated on a weekly basis. This document will provide the following:
 - 1. Cumulative load numbers for each shipment,
 - 2. A description of the waste material being shipped for disposal,
 - 3. Company transporting the waste material,
 - 4. Estimated waste volumes for each shipment,
 - 5. Certified weight slips for each shipment,
 - 6. The disposal facility of record for each waste stream, and
 - 7. The specific Manifest or Bill of Lading specific identifier number for the load being shipped for disposal.
- D. At the conclusion of the Project, all waste disposal information collected will be submitted to the Contracting Officer as an electronic deliverable package as part of the required project closeout record documentation. Payments to the Contractor for waste transportation disposal fees will not be approved until completed disposal tracking documents, as described above, are received by the Contracting Officer.

1.4 WASTE CONTAINERS

- A. The Contractor will provide waste containers specific to the individual waste to be handled.

1.5 FIELD VERIFICATION

- A. Field verify all new and existing dimensions affecting the work of this contract before ordering products.

1.6 TRANSPORTATION OF WASTES

- A. The Contractor will be responsible for the transportation of all wastes generated during the Project that cannot be salvaged, reused, or recycled. This includes materials generated by final Project Site cleanup activities and the dismantling of the temporary facilities and controls.
- B. The Contractor will be responsible for coordinating the number and schedule of vehicles required for offsite transportation of waste materials generated during the execution of the Project.
- C. The Contractor will be responsible for inspecting the transportation vehicles before and after loading to ensure compliance with all Local, State, and Federal regulations for the safe transport

of wastes from the Project Site to the receiving facility. The Contractor will provide the necessary labor and materials to ensure all trucks and containers are covered prior to departure.

- D. The Contractor will ensure that the transporters arriving at the Project Site for loading do not cause undue congestion to local roadways and will stage trucks either within the perimeter of the Project Site or at an offsite staging area approved by the Contracting Officer.
- E. The Contractor's transporters will proceed directly from the Project Site to a designated staging area or the designated offsite receiving facility. Temporary staging or storage of material will only be allowed at designated staging areas approved by the Contracting Officer.
- F. The Contractor will originate, maintain, and provide the Contracting Officer with a copy of each executed Bill of Lading for all loads shipped offsite. In addition, the Contractor will provide the Contracting Officer documentation and records verifying receipt of each truckload by the receiving facility. Such documentation will indicate the actual weight of each load shipped.
- G. Transporters will proceed from the Project Site along traffic routes established by the Contractor and approved by the Contracting Officer. Transporters will call back weights after each load and modify loads accordingly. The Contractor will ensure that trucks leaving the Project Site are within appropriate weight limitations for the local roads along the designated route.
- H. Weight measurements for materials transported to recycling and disposal facilities will be determined by scales certified in accordance with federal, state, and local regulations and requirements.

1.7 DISPOSAL OF WASTES

- A. The Contractor will be responsible for the proper disposal of all solid and liquid wastes that are generated during the execution of the Project in conformance with all Local, State, and Federal regulations and requirements. Proper disposal requires that the facility accepting the waste be a state-licensed disposal/recycling facility that is approved for acceptance of the waste based on the results of the characterization testing and analysis.
- B. The disposal facilities will be approved by the Contracting Officer prior to the transporting of waste. The Contractor will not change facilities without the prior written consent of the Contracting Officer.
- C. Obtain temporary EPA ID number(s) on behalf of the NPS, as directed by the Contracting Officer, for hazardous waste generated during the execution of this Project.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 02 81 01

SECTION 02 82 13 – ASBESTOS ABATEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work of this Section consists of the asbestos abatement tasks during the demolition of the Fall River Entrance Station buildings at Rocky Mountain National Park (ROMO) in Estes Park, Larimer County, Colorado (Project Site). Scope items and requirements for asbestos management are presented below.
- B. The estimated quantities of the asbestos-containing material (ACM) present in the building are described in Section E below.
- C. The abatement scope of work includes:
 - 1. Abatement of floor tile in the Office building. This non-friable ACM must be properly abated to avoid disturbing this flooring material during the demolition activities.
- D. The Contractor will take all necessary reasonable measures to control air and water pollution by any material or equipment used during asbestos abatement.
- E. Locations of identified ACM:
 - 1. Floor tile (FTC01): Approximately 160 square feet (sf) of 9-inch by 9-inch tan mottled floor tiles located in the office building contain between 3 and 5% chrysotile asbestos. The associated black mastic was identified to be none detect for asbestos via Polarized Light Microscopy (PLM). The FTC01 material is a Category I non-friable material. If this material is removed without mechanical means, it can be performed in a secondary enclosure. If mechanical means are used to remove the floor tiles, a full enclosure is required. Descriptions for both types of enclosures are included in Part III.
 - 2. No ACM was identified in the Kiosk buildings.
- F. The Contractor will be responsible for the collection and analysis of personnel exposure samples for asbestos in accordance with the U.S. Occupational Safety and Health Administration (OSHA) regulations.
- G. If suspect ACM is encountered in wall or ceiling interiors in unanticipated locations, the unforeseen condition will be documented and described, including the location, extent, and quantity of suspect ACM, and any immediate actions taken for safety or housekeeping purposes. This information will be provided to the Industrial Hygienist and the National Park Service (NPS) technical representative.
- H. Any ACMs of the nature shown or described, but not specifically called out or shown in the plans, but which are reasonably implied and necessary for a complete and satisfactory removal job will be included without additional cost to the Government.

- I. Applicable training will be provided by the Contractor prior to personnel performing abatement as required by applicable regulation 29 CFR 1926.1101 (asbestos). All persons conducting asbestos abatement work will receive compliant training per Title 40 of the CFR – Protection of the Environment.
- J. Two hours of asbestos awareness training will be provided to applicable NPS personnel and subcontractors working in the project facilities that contain ACM that reasonably can be expected to be impacted as part of this work.
- K. Third-party asbestos abatement oversight will be provided by an independent consultant contracted under the construction contractor. Third-party oversight by the Industrial Hygienist will be coordinated with the Contracting Officer to provide project surveillance, perimeter and clearance air sampling, and visual inspections. The clearance air samples will be analyzed using Phase Contrast Microscopy (PCM) in accordance with applicable regulations. All work and material will be subject to visual inspection by the Industrial Hygienist. The Contractor will provide reasonable and necessary facilities for such observation and will render the necessary assistance to permit the representative to carry out all phases of observation. When required by the Industrial Hygienist, the Contractor will take down or uncover portions of the finished work. If the work thus exposed is unsatisfactory, all costs and expenses of exposing, removing, re-testing, replacing, and restoring will be borne by the Contractor. Any omission or failure on the part of the Industrial Hygienist to disapprove or reject any inferior or defective work or material will not be construed to be an acceptance of any such work or materials. The Contractor will remove at its own expense any defective work or material rejected by the Industrial Hygienist and will rebuild or replace the same without extra charge to the Government. All re-testing of an area for clearance will be at the Contractor's expense.
- L. Contractors and employees should be prepared to comply with the OSHA Fall Protection Standard 29 CFR 1926 Subpart M while working at heights. In the event scaffolding is utilized during the prep or removal process, OSHA Standard 29 CFR 1926 Subpart L will apply.
- M. The Contractor will be responsible for the cleanup and testing of any area contaminated due to Contractor negligence at no additional cost to the NPS.

1.2 REFERENCES AND RELATED SPECIFICATIONS

- A. All work under this contract will be done in strict accordance with all applicable Federal, State, and Local regulations, standards, and codes governing asbestos abatement and other trade work done in conjunction with the abatement. The most recent edition of any relevant regulation, standard, document, or code will be in effect. Where conflict among the requirements or with these specifications exists, the most stringent requirements will be utilized.
- B. Section 02 81 01: Offsite Transportation and Disposal.

- C. Landmark Environmental, Inc., *Hazardous Materials Assessment Report for Rocky Mountain National Park, Fall River Entrance Station, Estes Park, Colorado. Landmark Project No. 21115.001.001* dated 02/23/22.
- D. American Society of Safety Engineers (ASSE), *ASSE/SAFE Z9.2 Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems*, 2012.
- E. Underwriters Laboratories (UL), *UL Standard for Safety High-Efficiency Particulate, Air Filter Units, UL 586*, 2009; reprint 2017.
- F. U.S. Occupational Safety and Health Administration (OSHA), 29 CFR 1910.1001, General Industry Standards for Asbestos.
- G. OSHA, 29 CFR 1926.1101, Construction Industry Standards for Asbestos.
- H. OSHA, 29 CFR 1926.62 Lead.
- I. OSHA, 29 CFR 1910.134, Respiratory Protection.
- J. OSHA, 29 CFR 1910.145, Accident Prevention.
- K. OSHA, 29 CFR 1910.2, Medical Records.
- L. OSHA, 29 CFR 1910.38, Emergency/Fire Prevention Programs.
- M. OSHA, 29 CFR 1910.1200, Hazard Communication.
- N. U.S. Environmental Protection Agency (EPA), 40 CFR 61 Sub. A, General Provisions.
- O. EPA, 40 CFR 61 Sub. B.
- P. U.S. Department of Transportation (USDOT) 49 CFR 171 and 172.
- Q. National Institute for Occupational Safety and Health (NIOSH), *Certified Equipment List*.
- R. NIOSH, *Occupational Exposure Sampling Strategy 77-173*.
- S. NIOSH, *Guide to Industrial Respiratory Protection*, 87-116.
- T. Colorado, 5 CCR 1001-10. *Asbestos Hazards Emergency Response Act. Regulation No. 8, The Control of Hazardous Air Pollutants, Part B – Emission Standards for Asbestos*.

1.3 DEFINITIONS AND ACRONYMS

- A. Asbestos: Includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered. Asbestos includes presumed ACM (PACM), as defined below.
- B. Asbestos-Containing Material (ACM): Any material containing more than 1% asbestos.
- C. Asbestos-Containing Waste Material (ACWM): Any material which is, or is suspected of being, a material contaminated with an ACM which is to be removed from a work area for disposal.
- D. Asbestos-Containing Construction Material: Any manufactured construction material which contains more than one-tenth of 1 percent asbestos by weight.
- E. Asbestos Debris: Pieces of ACM that can be identified by color, texture, or composition, or means dust, if the dust is determined by an accredited inspector to be ACM.
- F. Authorized Person: Any person authorized by the employer and required by work duties to be present in regulated areas.
- G. Class I Asbestos Work: Activities involving the removal of ACM that is a thermal system insulation or a surfacing material.
- H. Class II Asbestos Work: Activities involving the removal of ACM, which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard systems with ACM drywall joint compound, floor tile and sheeting, roofing and siding shingles, and construction mastics.
- I. Critical Barrier: One or more layers of plastic sealed over all openings into a work area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in a work area from migrating into an adjacent area.
- J. Competent Person: The Contractor's employee who is capable of identifying existing asbestos in the workplace, who has the authority to take prompt corrective measures to eliminate them, and who is trained and accredited as defined in 29 CFR 1926.1101 and 29 CFR 1926.62. The duties of the Competent Person include but are not limited to the following: controlling entry to and exit from the asbestos work area, supervising any employee exposure monitoring required by the standards, ensuring that all employees working within a work area wear the appropriate personal protective equipment and are trained in the use of appropriate methods of exposure control and decontamination, and ensuring that engineering controls in use are functioning properly.
- K. Disposal Bag: A properly labeled 6-mil leak-tight polyethylene bag used for containerizing and/or transporting asbestos waste to the disposal site.
- L. Disturbance: Activities that disrupt the matrix of ACM or PACM, crumble or pulverize ACM or PACM, or generate visible debris from ACM or PACM. Disturbance includes cutting away small

amounts of ACM and PACM, no greater than the amount which can be contained in one standardized glove bag or waste bag in order to access a building component. The maximum glove bag or waste bag size referred to herein is 60 inches in length and width.

- M. Friable Asbestos Material: Material that contains more than 1% asbestos by weight and that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.
- N. HEPA Filter: A High-Efficiency Particulate Air (HEPA) filter capable of trapping and retaining 99.97 percent of all mono-dispersed particles (e.g., asbestos fibers) of 0.3 microns in diameter.
- O. Industrial Hygiene: An area of specialization in the field of industrial safety and health that is concerned with predicting, recognizing, assessing, controlling, and preventing environmental stressors in the workplace that can lead to sickness, disease, or other forms of impaired health.
- P. Industrial Hygienist: A person having a college or university degree(s) in engineering, chemistry, physics, medicine, or related physical or biological sciences who, by virtue of special studies and training, has acquired competence in industrial hygiene.
- Q. Intact: ACM that has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix.
- R. Negative Initial Exposure Assessment: An assessment by an Industrial Hygienist which demonstrates that employee exposure during an operation is expected to be consistently below the permissible exposure limit (PEL) for representative eight-hour time-weighted average (TWA) samples and 30-minute excursion limit (EL) samples.
- S. Non-Friable Asbestos Material: Material that contains more than 1% asbestos by weight and that cannot be crumbled, pulverized, or reduced to a powder by hand pressure when dry.
- T. Personal Monitoring: Sampling of the asbestos fiber concentrations within the breathing zone of an employee.
- U. PACM: Presumed Asbestos-Containing Material means thermal system insulation and surfacing material found in buildings constructed no later than 1980.
- V. Regulated Area: An area established by the Contractor to demarcate areas where Class I, II, and III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work accumulate; and a work area within which airborne concentrations of asbestos, exceed or there is a reasonable possibility they may exceed, the permissible exposure limit.
- W. Removal: All operations where ACM and/or PACM are taken out or stripped from structures or substrates that include demolition operations.
- X. Renovation: Modifying any existing structure or portion thereof.

- Y. Surfactant: A chemical wetting agent added to water to improve wetting and penetration into a substrate.
- Z. Time-Weighted Average (TWA): The average concentration of a contaminant in the air during a specific time period.
- AA. Visible Emissions: Any emissions containing particulate asbestos material that are visually detectable without the aid of instruments.
- BB. Work Area: The area where asbestos-related work or removal operations are performed which is defined and/or isolated to prevent the spread of asbestos dust, fibers or debris, and entry by unauthorized personnel. A Work Area is a Regulated Area as defined by 29 CFR 1926.1101.

1.4 FIELD VERIFICATION

- A. Field verify all new and existing dimensions affecting the work of this contract before ordering products.

1.5 CONSTRUCTION MATERIALS

- A. The Government will not furnish any materials for this project.

1.6 SALVAGED MATERIALS

- A. Excess salvaged materials not reinstalled in the project remain the property of the Government.
- B. Stockpile material within the rooms where the materials are recovered for reuse. If more space is required, coordinate storage location with Contracting Officer.

1.7 PROJECT SUBMITTAL REQUIREMENTS

- A. Pre-Project Submittals:
 - 1. Proof that required Federal, State, and Local permits have been obtained.
 - 2. Proof of asbestos-specific insurance demonstrating both liability and pollution coverage. The policy will name the NPS as an additional insured and will include a waiver of subrogation. Policy limits will be a minimum of two million dollars (\$2,000,000).
 - 3. Health and Safety Related Submittals: The Contractor will submit to the Contracting Officer for review an Asbestos-Specific Health and Safety Program including, but not limited to: a Respiratory Protection Program, a Medical Surveillance Program, and an Accident Prevention Program. Additional health and safety-related submittals required are:
 - a. The Contractor will submit the resume and copies of professional registrations/certifications for the Contractor's employee who will act as the Competent Person for the project. The Competent Person must meet the qualifications and have the training and certifications defined by OSHA.

- b. Proof that all employees have passed appropriate medical examinations required by OSHA.
 - c. Certification that all employees have been instructed on the hazards of asbestos exposure, use and fitting of respirators and protective dress, use of showers, work area entry and exit procedures, work methods, and protective measures.
 - d. Certification that each employee has been properly fitted with a specified respirator.
 - e. If rental equipment is to be used in the work area or to transport asbestos-contaminated waste, provide notice to the rental agency stating the intended use of equipment, with a copy to the Industrial Hygienist.
 - f. For each type of training session, the Contractor will submit a proposed outline of the subjects to be covered to the Industrial Hygienist for approval. The training will not be conducted until the outline is approved.
 - g. Copies of attendance records and certificates for each employee for all asbestos training as required by this Section.
 - h. Copies of current physicians' written medical opinions for all employees subject to medical surveillance requirements defined in OSHA respiratory Protection Standards.
4. Asbestos Abatement Project Plan: Develop and submit to the Contracting Officer for review a written Asbestos Abatement Project Plan. This plan should meet the requirements of a Project Design and be prepared by a certified Project Designer. The plan will be job-specific and list the work procedures to be used during the removal of asbestos from the Ranch House and Bunkhouse. This work plan will include, but not be limited to:
- a. Construction schedule in sufficient detail for the Contracting Officer to determine the duration and level of effort required for the project.
 - b. Description, accompanied by sketches to scale, of decontamination enclosure systems.
 - c. Description of asbestos waste handling procedures. Include name and address of waste disposal site; name, address, and telephone number of the entity which will transport asbestos waste; and a sample of transport manifest to be used to identify the quantity of waste removed and accepted by disposal site.
- B. Asbestos-Related Project Submittals – Ongoing Requirements:
- 1. Results of all worker exposure assessment air samples will be made available to applicable personnel per OSHA 29 CFR 1926.1101 and will also be submitted to the Industrial Hygienist or a designated onsite representative within 24-hours of sample collection. Submittals will include sample collection logs and laboratory analysis sheets.
 - 2. After every disposal operation, provide copies of transport manifests, disposal receipts, and chain-of-custody forms for all asbestos waste materials removed from the site. Chain-of-custody form will include the date, address of pickup site, name and address of Contractor, names of persons responsible for pickup, name and address of disposal site, quantity of asbestos waste, and type of containers used. The form will be signed by the Contractor, the Contracting Officer, disposal site operator, and hauler if a private hauler is employed.
- C. Close-out Report: Prepare a close-out report with the following items:
- 1. Description of removal activities performed during the project.
 - 2. Pre- and post-work photographs.
 - 3. Description and results of all occupational and environmental sampling.
 - 4. Description and results of third-party final clearance activities.

5. Results of waste characterization sampling.
6. Copies of all ACWM manifest documents will be completed and signed by the Contracting Officer, the Contractor, the Transporter, and the Disposal facility.

1.8 QUALITY ASSURANCE

- A. Qualifications: Workers will be fully qualified and experienced in the techniques of abatement, handling, and disposal of ACMs and meet the requirements as set forth by OSHA and the EPA.
- B. Regulatory Requirements:
 1. Comply with OSHA Safety and Health Standard (29 CFR 1910.1001); OSHA Asbestos Regulation for the Construction Industry (29 CFR 1926.58); National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR, Part 61, Subparts A and B); Asbestos Hazard Emergency Response Act (AHERA) (40 CFR, Part 763); Colorado Regulation 8, Part B, and DOT regulations for transporting asbestos-containing waste.
 2. Notify all responsible State and Local agencies in writing at least ten days before removal work begins. Obtain all required permits before work begins. The Contractor will be responsible for obtaining all necessary permits and certifications of personnel in conjunction with asbestos removal, hauling, and disposition and provide timely notification of such actions as may be required by Federal, state, regional and local authorities. Fees and/or charges for these permits will be included in the Contractor's bid price. Provide copies of all obtained permits to the Industrial Hygienist/Contracting Officer.
 3. Dispose of asbestos waste at an authorized landfill site in accordance with requirements of NESHAP and applicable state and local guidelines and regulations.

1.9 RECORDKEEPING

- A. Daily Project Log: The Project Site Supervisor must maintain a Daily Project Log. The Daily Project Log must be used each day of the project to document the following information:
 1. Date.
 2. Name of Supervisor.
 3. Name of Industrial Hygienist monitoring work area (if applicable).
 4. Manometer data (if applicable)
 5. Number of workers on site.
 6. Equipment utilized.
 7. Brief description of daily work activities.
 8. Listing of any non-compliance noted, emergencies, stop work orders (with detailed explanation), and descriptions of any other significant events.

1.10 PROJECT CONDITIONS

- A. Maintain existing emergency exits and building emergency equipment, such as fire alarms, fire hose equipment, and emergency lighting devices, in operating order.

- B. Do not damage existing building materials that are not associated with the work or work area. Any damage to building materials not protected within the work area or that are outside the work area and not associated with the work will be repaired or replaced by the Contractor at no cost to the Government.

- C. Wall, ceiling, and flooring systems can include multiple layers. Due to the inconsistency of these systems and the potential for overlay materials, all systems will be assumed to be ACMs unless specifically sampled and confirmed to be non-ACM. If the work will impact the wall, ceiling, or flooring systems, any material uncovered that was not previously sampled must be assumed to be asbestos. Samples of the uncovered material will be taken by a competent person, and work will be stopped until the competent person allows work to continue. If suspect ACM is encountered in wall or ceiling interiors in unanticipated locations, the unforeseen condition will be documented and described, including the location, extent and the quantity of suspect ACM, and any immediate actions taken for safety or housekeeping purposes. This information will be provided to the Industrial Hygienist or the NPS technical representative.

PART 2 - PRODUCTS

2.1 PERSONAL PROTECTIVE EQUIPMENT

- A. Respiratory Protection:
 - 1. Workers who abate asbestos will be provided with personally issued, individually identified respirators that meet the required level of protection. During pre-cleaning, installation of critical barriers, and HEPA vacuuming activities, the Contractor will utilize (at a minimum) half-face air-purifying respirators with approved HEPA filter cartridges. At a minimum, the Contractor will utilize Powered Air Purifying Respirators (PAPR) for removal and cleanup work.
 - 2. The Contractor will provide workers with and require the use of respirators approved by NIOSH for asbestos in accordance with OSHA Standard 29 CFR 1926.1101. The minimum respiratory protection allowable will be an approved half-mask air-purifying respirator with HEPA cartridges. Half-mask respirators will be used during pre-cleaning only. A full-face piece will be required at all other times. Disposable single-use respirators will not be permitted. The initial respiratory protection provided will be chosen prior to commencement of removal operation based on data from past exposure assessment monitoring or initial monitoring performed to accurately determine the airborne concentration of asbestos to which employees may be exposed.
 - 3. Workers must perform positive and negative air pressure fit tests each time a respirator is put on, whenever the respirator design so permits. Powered air-purifying respirators will be tested for adequate flow as specified by the manufacturer.
 - 4. Workers will be given a qualitative fit test in accordance with procedures detailed in OSHA 29 CFR 1926.1101 for all respirators to be used. An appropriately administered quantitative fit test may be substituted for the qualitative fit test. Documentation of adequate respirator fit must be provided to the Contractor. Fit tests will be administered annually.

B. Personal Protection required for Asbestos Abatement:

1. Prior to the commencement of abatement activities, all personnel who will be required to enter the work area for handling containerized ACMs must have received the required training. Special onsite training on equipment and procedures unique to this job site will be performed as required. Training in emergency response and evacuation procedures will also be provided.
2. All respiratory protection will be provided to workers through a written respiratory protection program. This program will be posted in the cleanroom of the worker decontamination enclosure system.
3. Disposable clothing, including head, foot, and full-body protection will be provided in sufficient quantities and adequate sizes for all workers and authorized visitors. All personnel engaged in asbestos removal work will wear approved disposable protective clothing constructed of spun-bonded olefin or polypropylene fabrics, or other material of equivalent resistance to penetration by asbestos. A full-body suit is recommended in lieu of a separate set of coveralls, head covers, and shoe covers. Disposable whole-body clothing, including head covers, gloves, and shoe coverings, will be provided to and worn by all personnel in the asbestos control area. If elastic sleeve closures are not provided, sleeves will be secured with duct tape to gloves. Washable footwear having a non-skid tracking surface will be provided and used by all personnel within the asbestos control area.
4. Persons having facial hair which may interfere with the seal of a respirator will not be allowed to enter the work area.
5. Contaminated clothing will be treated as ACM and undergo the same disposal procedures.
6. The Contractor will, at all times, have available for use by the Industrial Hygienist, two clean sets of personal protective equipment and clothing (excluding air-purifying negative-pressure respirators, which will be provided by individual visitors), as required for entry in asbestos work areas by these specifications.
7. Respirators will be worn at all times if asbestos materials are impacted to the extent that airborne emissions are created.
8. Protective eyewear, gloves, rubber boots and/or other footwear will be provided as required for workers and authorized visitors. Safety shoes may be required for some activities.
9. Eating, drinking, smoking, and chewing gum or tobacco will not be allowed in the work area.

2.2 HEPA-Equipped Filtration Equipment

- A. Vacuum Equipment: HEPA filtered vacuuming equipment with a filter system capable of collecting and retaining asbestos fibers. Filters will be 99.97 percent efficient for retaining fibers 0.3 microns or larger.
- B. If full containment enclosures are constructed during friable asbestos abatement, a sufficient quantity of negative pressure ventilation units will be used, equipped with HEPA filters and operated in accordance with ASSE/SAFE Z9.2 (local exhaust ventilation requirements), EPA guidance document EPA 560/5- 83-002 (Blue Book), and EPA 560/5-85/024 (Purple Book). The Industrial Hygienist will inspect all negative air machines after installation and prior to asbestos removal. Inspection will include visual inspections of HEPA filters for physical/water damage,

and the negative air machine (NAM) filter logbook will be checked. Filter use will not exceed manufacturers' recommended machine hours (typically 600 to 900 hours). The Contractor will use only those brands manufactured and tested for commercial purposes. No "homemade" units will be permitted. HEPA filters will be approved by UL 586.

- C. For friable ACM abatement, provide fully operational negative pressure systems supplying a minimum of one air change every 15 minutes. Determine the volume in cubic feet of the work area by multiplying the floor area by the ceiling height. Determine total ventilation requirement in cubic feet per minute (cfm) for the work area by dividing this volume by the air change rate.
- D. Locate negative air machines (NAMs) so that makeup air enters the work area primarily through the decontamination facilities and transverses the NAMs at a maximum distance from the worker access opening or other makeup air sources. Place the end of the unit or its exhaust duct through an opening in the plastic barrier or wall covering. The plastic around the unit or duct will then be sealed with tape. Vent outside of building, unless authorized in writing by the Industrial Hygienist or the NPS technical representative.

2.3 PLASTIC SHEETING

- A. 6 mils inch and sized to minimize the frequency of joints.
- B. Polyethylene sheeting utilized for worker decontamination enclosure will be opaque white or black.

2.4 TAPE

- A. For use under dry and wet conditions, capable of being cleaned off surfaces without permanent marks or damage to the substratum.

2.5 CONTAINERS

- A. Asbestos wastes will be stored in air and watertight, 55-gallon metal or fiberglass drums with tightly fitting lids, lined with 6 mil plastic bags. Label containers in accordance with OSHA 1910.1001.
- B. Disposal drums (if applicable) will be metal with locking ring tops and inner 6 mil polyethylene liners.
- C. Stick-on warning labels, as per EPA or OSHA requirements, will be used on all disposal drums. All drums must additionally be labeled with a DOT code.

2.6 OTHER MATERIALS

- A. Surfactant (wetting agent) will be a 50/50 mixture of polyoxyethylene ether and polyoxyethylene ester, or equivalent, mixed in a proportion as specified by the manufacturer.

- B. Encapsulation materials will be either the penetrating or bridging type, pollution-free, non-toxic, with a Class A fire classification as specified herein. The material will be flexible when cured, resistant to weathering, oxidation, aging, and abuse. The Contractor will submit product data, use instructions, and recommendations from the manufacturer for products intended for use.
- C. Provide all other materials required for temporary construction.

PART 3 - EXECUTION

3.1 HOUSEKEEPING

- A. Establish Regulated Areas per OSHA 29 CFR 1926.1101. Demarcate all Regulated Areas per OSHA.
- B. Keep the project neat, orderly, and in a safe condition at all times. Use wet methods and HEPA-equipped vacuums only to collect all dust, waste, debris, etc., in areas where ACMs are impacted. Prohibit the use of dry sweeping or vacuuming without using HEPA-equipped vacuums.
- C. All powered hand tools and equipment used to impact ACMs or PACMs must be equipped with point of contact HEPA-equipped vacuum attachments, and/or the materials must be thoroughly wetted with an effective wetting agent suitable for the material and operation.
- D. Access to the work area must be restricted to "authorized persons" only as defined in OSHA 29 CFR 1926.1101. This may be accomplished by the use of properly demarcated critical barriers, securing adjacent access points, or installing barrier plastic sheeting (containments for Class I work) and signs following implementation of compliant Negative Exposure Assessment activities and at the direction of the competent person.
- E. The Contractor will verify locations of utilities prior to any environmental abatement and interior demolition work. Existing water, sewer, electrical, communications, and gas lines located within the boundaries of the environmental abatement work will be located, and non-essential utilities will be properly locked and tagged out at the limits of the environmental abatement or selective demolition work. This work will require a qualified and licensed electrician to verify safety and proper lockout.
- F. Unless and until a Negative Exposure Assessment is produced, establish an equipment room or area adjacent to the regulated area for the decontamination of employees and their equipment that is contaminated with asbestos.
- G. Provide enough containers for collecting ACWM and construction debris.
- H. Place drop cloths adjacent to areas where impacts to ACM will occur.

- I. Use a HEPA-equipped vacuum and/or wet methods to clean up any dust, debris, or other waste materials that may contain or be contaminated with ACWM.
- J. No dry sweeping is permitted at any time during any activities conducted on or around any ACMs such that any waste dust, debris, or other items may be contaminated.
- K. Thoroughly wet all dry or drying ACMs and general rubbish to prevent creating dust.
- L. Keep ACWM adequately wet and in covered containers.
- M. Ensure that employees do not smoke in work areas where they are occupationally exposed to asbestos as a result of activities in or around that work area.

3.2 FIRE SAFETY

- A. The Contractor will take the following precautions against fire:
 - 1. The Contractor will comply fully with requirements of the Federal, State, and Local Government, Owner, Owner's Representative, including stipulations as outlined below. The Contractor will maintain and enforce all regulations imposed and will be required to secure such protection as may be required. In the event of strikes, these precautions will not be relaxed. The Contractor is responsible for acquainting the local Fire Department with existing conditions.
 - 2. The Contractor will not impede or void the essential function of emergency fire exits while performing abatement work.
 - 3. At least one qualified person thoroughly familiar with fire protection and prevention will be on duty at all hours that the Contractor's employees are working. This person will patrol the entire work area frequently and will have the authority to take immediate remedial action to eliminate unnecessary fire hazards.
 - 4. Building material storage will be limited to secure areas within the building or, where stored outside, will be kept at least ten feet away from the building. Storage areas will be approved by the Owner's Representative.
 - 5. Fire extinguishers: Maintain and provide approved fire extinguishers throughout all accessible areas. Placement, inspection, and maintenance of fire extinguishers will comply with 29 CFR 1926.130. The Contractor will provide at least one 20 ABC fire extinguisher for every 3,000 square feet of the work area, with a maximum distance of 100 feet between fire extinguishers. The Contractor will place (at a minimum) ABC fire extinguishers in the following locations:
 - a. Cleanroom of personnel decontamination facility.
 - b. Equipment room of personnel decontamination facility.
 - c. Within the containment, at least one extinguisher for every 3,000 square feet of the work area with a maximum distance of 100 feet between fire extinguishers.
 - 6. Gasoline, oils, and other volatile liquids will be kept outside, to be brought into the building in quantities only as needed. Such storage will be in a well-ventilated location, removed from all open heating or lighting devices. Storage areas will be approved by the NPS.

7. Electrical wiring for construction light and power will be a properly fused, ground fault circuit interrupter (GFCI) installed to conform to basic code requirements and maintained under the supervision of a competent electrician. This also applies to all temporary lines used by the Contractor.
8. During any torch-cutting activities, the Contractor will take necessary steps to comply with 29 CFR 1926 Subpart J (1926.350-1926.353), including provisions addressing transportation and storage of oxygen and acetylene cylinders, fire prevention, and ventilation. The Contractor will utilize persons trained and knowledgeable in all equipment used onsite.

3.3 FULL ENCLOSURE PREPARATION

- A. Full enclosure containments will be constructed of two layers of 6 mil poly sheeting on all walls, ceilings, floors and/or other surfaces not being abated.
- B. Post caution signs in and around the work area to comply with OSHA 1910.1001(g)(1) and Federal, State, and Local regulations.
- C. Shut down and lock out all heating, cooling, and air-conditioning system components that supply or pass through the work area.
- D. Seal off openings, such as corridors, doorways, windows, vents, ducts, grilles, diffusers, switch and outlet boxes, and lighting fixtures, with one layer of 6 mil poly sheeting sealed with duct tape.
- E. Clean items to be removed from the work area using HEPA vacuum equipment and/or wet cleaning methods. Remove cleaned items to a temporary location as directed by the Consultant.
- F. Clean items to remain in the work area using HEPA vacuum equipment and/or wet cleaning methods, and enclose with one layer of 6 mil poly sheeting sealed with duct tape. Protect items with temporary barricades, covers, or pads as necessary to prevent damage.
- G. Clean work area using HEPA vacuum equipment and/or wet cleaning methods.
- H. Establish negative pressure within the work area prior to erecting the enclosure.
- I. Cover floors, then walls, with 6-mil poly sheeting sealed with duct tape.
 1. Cover floors with a minimum of two layers of plastic sheeting. Extend plastic at least 24 inches up walls. Cover walls with a minimum of two layers of plastic sheeting to the floor level. Extend the plastic at least 12 inches onto the floor in an overlapping manner with the floor. (e.g., install floor, wall, floor, wall with the wall being the top layer of sheeting.)
- J. Each full enclosure will have an attached decontamination unit and loadout chamber.

3.4 SECONDARY ENCLOSURES PREPARATION

- A. Secondary enclosure containments will be constructed of one layer critical barrier of 6 mil poly sheeting over all windows, doors, vents, and openings or penetrations into the works area.
- B. Post caution signs in and around the work area to comply with OSHA 1910.1001(g) (1) and Federal, State, and Local regulations.
- C. Shut down and lock out all heating, cooling, and air-conditioning system components that supply or pass through the work area.
- D. Seal off openings, such as corridors, doorways, windows, vents, ducts, grilles, diffusers, switch and outlet boxes, and lighting fixtures, with one layer of 6 mil poly sheeting sealed with duct tape.
- E. Clean items to be removed from the work area using HEPA vacuum equipment and/or wet cleaning methods. Remove cleaned items to a temporary location as directed by the Consultant.
- F. Clean items to remain in the work area using HEPA vacuum equipment and/or wet cleaning methods, and enclose with one layer of 6 mil poly sheeting sealed with duct tape. Protect items with temporary barricades, covers, or pads as necessary to prevent damage.
- G. Clean work area using HEPA vacuum equipment and/or wet cleaning methods.
- H. Establish negative pressure within the work area prior to erecting the enclosure.
- I. Cover porous or non-cleanable surfaces and objects with 6-mil poly sheeting sealed with duct tape.
- J. Each secondary enclosure will have an attached decontamination chamber.

3.5 DECONTAMINATION ENCLOSURE SYSTEMS – REQUIRED FOR ABATEMENT

- A. During abatement, a worker decontamination system will be provided in at least one pre-designated location for each location where a regulated asbestos area is established. Pre-constructed decontamination trailers are permitted.
- B. If decontamination units are constructed onsite, plans for construction, including materials and layout, will be submitted as shop drawings and approved in writing by the Contractor prior to work initiation. Worker decontamination enclosure systems constructed at the worksite will utilize 10-mil opaque black or white polyethylene sheeting or other acceptable materials for privacy.
- C. The worker decontamination enclosure system will consist of at least a clean room, a shower room, and an equipment room, each separated from the other and from the work area by airlocks.

- D. Entry to and exit from all airlocks and decontamination enclosure system chambers will be through curtained doorways consisting of three sheets of overlapping polyethylene sheeting. Each sheet will be secured at the top and staggered from left to right for subsequent sheets. All sheets will have weights attached to the bottom to ensure that they hang straight and maintain a seal over the doorway when not in use. Doorway designs, providing equivalent protection and acceptable to the Industrial Hygienist may be utilized.
- E. Access between any two rooms in the decontamination enclosure system will be through an airlock with at least 3 feet separating each curtained doorway. Pathways into (from clean to contaminated) and out from (contaminated to clean) the work area will be clearly designated.
- F. The cleanroom will be sized to adequately accommodate the clothes, equipment, and supplies for the work crew. Clean disposable clothing, replacement filters for respirators and towels, and other necessary items will be provided in adequate supply at the cleanroom. A location for postings will also be provided in this area. Whenever possible, a lockable door will be used to permit access into the cleanroom from outside the work area. Lighting, heat, and electricity will be provided as necessary for comfort. No asbestos-contaminated items may enter this room. Workers will use this area to suit up, store street clothes, don respiratory protection on their way to the work area, and dress in street clothes after showering.
- G. The shower room will contain one or more showers as necessary to adequately accommodate workers. Each showerhead will be supplied with hot and cold water adjustable to the tap. The shower enclosure will be constructed to prohibit leakage of any kind. The Contractor will supply and keep available at all times an adequate supply of soap, shampoo, and towels. Shower water will be drained, collected, and filtered through a system with at least 5-micron particle size collection capability. All filtered water will be stored for subsequent treatment by the Contractor. The shower should be constructed to ensure against leakage of any kind and will be kept clean of all debris and ACM at all times.
- H. The equipment room will be used for the storage of equipment and tools at the end of a shift after they have been decontaminated using a HEPA filtered vacuum and/or wet cleaning techniques as appropriate. Replacement filters (in sealed containers until used) for HEPA vacuums and negative pressure ventilation equipment, extra tools, containers of surfactant, and other materials and equipment that may be required during the abatement may also be stored here as needed. A pan filled with water will be located in the work area just outside the equipment room for workers to clean off foot coverings after leaving the work area and prevent excessive contamination of the worker decontamination enclosure system. A container lined with a labeled 6-mil polyethylene bag for the collection of disposable clothing will be located in this room. Contaminated footwear (e.g., rubber boots, other reusable footwear) will be stored in this area for reuse the following workday.
- I. If a full containment enclosure is constructed for abatement of friable ACM, the container/equipment decontamination unit configuration is roughly the same as the personnel decontamination system described above. All materials, equipment, and bagged ACM will be decontaminated in this unit. This area will be separate from the personal decontamination unit

and will be used for decontamination and temporary storage of bagged waste and equipment. All waste-load-out areas must have a minimum of two separate chambers separated by airlocks. The size of each container/equipment decontamination unit chamber is dependent on the type of materials to be passed out of the container/equipment decontamination unit. Each separate airlock must be of sufficient size to fully contain, within the individual airlock, any item passed out through the container/equipment decontamination unit. If the regulated area is not a fully enclosed containment, the waste transfer area will be designated, and all waste will be transferred through that location only.

- J. A worker outside the regulated area will hand an unused bag to the worker in the regulated area. A worker in the containment chamber will deposit a sealed bag containing asbestos into this unused bag. The double-bagged material will then be sealed and passed into the waste transfer station, wiped down, and passed outside of the regulated area. If equipment is used to transfer wrapped components, the equipment will pass through the waste transfer, and any visible debris on the wrapped components or the equipment will be wet-wiped or washed with an airless sprayer.
- K. The container/equipment decontamination system will be equipped with the necessary facilities to wash and wipe the outside of the bags, drums, or other items prior to loading them into the vehicle for transportation to a landfill. Provisions will be made by the Contractor to prevent any contaminated run-off from leaving the decontamination system. All wastewater from the area will be filtered through a multi-part filter system with a final pore size of 5.0 microns, nominal. The container/equipment decontamination system will be equipped with the necessary facilities to wash and wipe the equipment leaving the containment.

3.6 WORK AREA ENTRY AND EXIT PROCEDURES

- A. If a containment enclosure is constructed, emergency exits will be established and clearly marked with duct tape arrows or other effective designations to permit easy location from anywhere within the work area. They will be secured to prevent access from uncontaminated areas and still permit emergency exiting. These exits will be properly sealed with polyethylene sheeting, which can be cut to permit egress if needed. These exits may be the worker decontamination enclosure, the waste pass-out airlock and/or other alternative exits satisfactory to fire officials. For non-enclosed regulated areas, the routes of egress will be clearly identified and communicated to all workers.
 1. All workers and authorized personnel will enter the regulated area through the worker decontamination enclosure system and must sign the entry log located in the cleanroom upon entry and exit.
 2. All personnel entering any work area will read and be familiar with all posted regulations, personal protection requirements, including workplace entry and exit procedures, and emergency procedures. A sign-off sheet will be used to acknowledge that these have been reviewed and understood by all personnel prior to entry.
 3. All personnel will proceed first to the cleanroom, remove all street clothes, and put on required respiratory protection, disposable coveralls, head covering, and foot covering. Hard hats, eye protection, and gloves will also be utilized if required. Clean respirators and

protective clothing will be provided and utilized by each person for each separate entry into the work area.

4. Personnel wearing designated personal protective equipment will proceed from the cleanroom through the shower room and equipment room to the main work area.
 5. Before leaving the work area, all personnel will remove gross contamination from the outside of respirators and protective clothing by brushing and/or wet wiping procedures. Each person will clean the bottoms of protective footwear in the walk-off pan just prior to entering the equipment room. Upon entering the equipment room, they will then remove protective equipment except for respirators. Deposit all disposable clothing into appropriately labeled containers.
 6. Reusable, contaminated footwear will be stored in the equipment room when not in use in the work area. Upon completion of abatement, it will be disposed of as asbestos-contaminated waste. Rubber boots may be decontaminated at the completion of the abatement for reuse.
 7. Still wearing respirators, personnel will proceed to the shower area, clean the outside of the respirators, and the exposed face under running water prior to removal of respirator, and shower and shampoo to remove residual asbestos contamination. Various types of respirators will require slight modification of these procedures. An airline respirator with HEPA filtered disconnect protection may be disconnected in the shower. Care must be taken with a powered air-purifying respirator facepiece since the filter/power pack assembly is not waterproof. A dual cartridge respirator may be worn into the shower. Cartridges must be replaced for each new entry into the work area. After showering and drying off, proceed to the cleanroom to don clean disposable clothing if returning to the work area or street clothes if leaving the work area.
- B. Cartridges used on half-face or full-face APRs will be disposed of each time a worker leaves the asbestos control area (after showering).
- C. If used, PAPR cartridges may be capped after the worker leaves the asbestos control area and has completed initial showering (prior to removing the respirator). When PAPR cartridges become wet or filter loading decreases airflow below 4 CFM, the PAPR cartridges must be disposed as ACM.
- D. The following provides clarification of decontamination procedures to workers once workers have removed and disposed of disposable clothing (Tyvek suit with hoods and boots and disposable gloves) and have removed and stored protective footwear, headwear, and eyewear in the equipment room. Workers wearing half-face APRs will proceed to the shower and shower total body (soap and shampoo) with emphasis on running water over the exposed face and the outside of the respirator. Once residual contamination on the head, body, and respirator has been removed, the worker will open a re-sealable bag, remove saturated cartridges and place cartridges into and seal the re-sealable bag. The worker will complete additional showering and exit to the cleanroom.
- E. Replacement (new) respirator cartridges will be stored on shelving in the cleanroom in original packaging. Cartridges will not be stored on the floor or in other locations where water and/or physical damage may occur.

3.7 ASBESTOS REMOVAL WORK

- A. Upon completion of the asbestos removal work, the Contractor will submit a written statement to the NPS attesting that all items containing asbestos have been disposed of in accordance with EPA 40, CFR, Part 61, Subpart M in the approved sanitary landfill(s). Documentation will include proof of regulatory approval and copies of completed Waste Shipment Records signed by generator, transporter(s), and disposal site operator and listing the following information:
1. Name, address, and telephone number of the waste generator.
 2. Name and address of Local, State, or EPA Regional agency responsible for administering the asbestos NESHAP program.
 3. Quantity of ACWM in cubic meters or yards.
 4. Name and telephone number of the disposal site operator.
 5. Name and physical location of the disposal site.
 6. Date transported.
 7. Name, address, and telephone number of the transporter(s).
 8. A certification that the contents of the shipment are fully and accurately described by the proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to all applicable international and governmental regulations.

3.8 AIR MONITORING

- A. Air samples for asbestos may be collected adjacent to the abatement work areas by the Industrial Hygienist each day abatement occurs. Asbestos air samples will be analyzed by the Industrial Hygienist at the end of each work shift. The purpose of the abatement perimeter monitoring is to detect faults in the work area isolation such as:
1. Contamination of the areas/building outside of the work area with airborne asbestos particles;
 2. Failure of filtration or rupture in the differential pressure system (if used) causing contamination of air outside with airborne asbestos dust; and
 3. Should any of the above occur, immediately cease abatement activities until the fault is corrected. Do not recommence work until authorized by the Industrial Hygienist.
- B. If at any time in the abatement process that the outside work area monitoring results indicate that the asbestos concentration is at or above 0.01 fibers per cubic centimeter, CEASE ALL WORK except corrective action. After correcting the cause of unacceptable levels outside the work area, HEPA vacuum all surfaces that potentially could be contaminated; wet-wipe, using amended

water, all wettable surfaces; and HEPA vacuum a second time. Complete corrective work with no change in the contract Sum if high airborne asbestos levels were caused by the Contractor's activities.

- C. Aggressive final clearance air samples for asbestos will be collected in each asbestos removal area. The Industrial Hygienist will collect clearance air samples for PCM analysis. If the air samples do not meet the post-abatement standard of 0.010 f/cc, the work area will be re-cleaned until acceptable air levels are achieved at no additional cost to the Government. The asbestos abatement action will be considered complete when clearance air samples result in acceptable air concentrations. Failed clearance costs will be the responsibility of the Contractor.

3.9 ABATEMENT WORK PRACTICES

- A. The following sections describe protocols to be used for the various abatement tasks associated with this project. After all personal protection and containment controls are implemented, the abatement task sequence will be as follows:
 1. Shut down and lock out all HVAC, mechanical or refrigeration equipment within the work area.
 2. Initiate pressure differential system using HEPA filtered ventilation devices. Exhaust must be vented to the outside. Units are to be sized to achieve a minimum of one complete air change within the area every 15 minutes.
 3. Construct a worker decontamination system at the entrance to the work area. Construct a waste pass-out decontamination system.
 4. Pre-clean all mechanical equipment, floors, and walls.
 5. Install critical barriers. Seal off any penetration or entrances into the work area using one layer of 6-mil polyethylene sheeting and tape. Polyurethane sealant foam may be used for small penetrations.
 6. Complete containment barriers as per specification.
 7. Approval of worker decontamination system(s) and containment system will be approved in writing prior to initiation of removal or repair activities.
 8. Remove and properly dispose of existing friable and non-friable ACM.
 9. Upon completion of removal or repair activities, the Contractor will request a final inspection of the work area by the Industrial Hygienist. All surfaces are to be thoroughly cleaned prior to this request.
 10. Upon the work area being declared visually clean, aggressive sampling of the work area will occur for air clearance. All but critical barriers will be removed prior to sampling.
 11. If air sampling indicates area clearance in accordance with specifications, the area will be declared clean, and all remaining polyethylene, tape, debris, etc., will be removed and bagged as asbestos-contaminated waste.
 12. An encapsulating agent will be applied to surfaces from which ACM has been stripped if total decontamination or component removal cannot be accomplished. Approval from the Industrial Hygienist must be obtained before applying encapsulant.
 13. All asbestos waste must be adequately wet as defined in the EPA/NESHAP Guidance dated December 1990. Per the EPA Guidance, "adequately wet" means to "sufficiently mix or

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penetrate with liquid to prevent the release of particles." If visible emissions are observed coming from ACM waste, then the material is not adequately wet. The absence of visible emissions is not sufficient evidence of being adequately wet. All abated materials, regardless of whether they are first stripped from their substrate, must be adequately wet prior to disposal.

3.10 PROJECT DECONTAMINATION AND FINAL CLEARANCE

- A. At the conclusion of the active abatement process, all surfaces in the abatement area should be thoroughly and completely HEPA vacuumed. These surfaces include but are not limited to ceilings, walls, floors, windows, doors, fixtures of any kind, and appliances. This includes not just abated surfaces but also un-abated surfaces exposed to asbestos dust generated by the abatement process. All areas should be included in this HEPA process, except for spaces that:
 - 1. Were found free of asbestos dust before the abatement process began;
 - 2. Were properly sealed before the abatement process began; and
 - 3. Were never entered during the abatement process.

- B. Wet Wiping
 - 1. Use Proper Wet Cleaning Procedures: At the conclusions of the active abatement process and after the first HEPA vacuuming, all surfaces identified as requiring HEPA vacuuming earlier should be thoroughly and completely washed with an amended water solution.
 - 2. Change Cleaning Mixture Regularly: To avoid re-contaminating the area by using overly dirty water, users should carefully follow surface area limits and change the cleaning mixture accordingly. Users must ensure that the dirty water does not re-contaminate the environment. This dirty water is potentially hazardous and should be treated accordingly.

- C. Final Inspection
 - 1. After the final cleanup is complete, the final inspection will take place. The Industrial Hygienist will require 24-hour advanced notice of work areas prepared for the final inspection. The objective of the inspection is to ensure abatement completeness and verify that no visible dust, dirt, or debris is present.
 - 2. Post-abatement visual inspection will be performed to confirm job completeness by determining whether all surfaces have been abated according to the approved abatement plan. The inspector will present the Contractor with the list of items to complete before the inspection process can continue.

3.11 RE-ESTABLISHMENT OF THE WORK AREA AND SYSTEMS

- A. Re-establishment of the work area to general access will only occur following the completion of cleanup procedures and/or after clearance air monitoring has been performed and documented to the satisfaction of the Industrial Hygienist.

- B. The Industrial Hygienist will visually inspect the work area for any remaining visible residues. Evidence of contamination will necessitate additional cleaning and additional air monitoring. Following satisfactory clearance of the work area, remaining polyethylene barriers may be removed and disposed of as asbestos-contaminated waste.
- C. Upon successful completion of the final air monitoring, the Contractor will allow the NAMs to operate until all critical barriers are removed and sealed in disposal bags. The barriers will be disposed of as ACM. Removal of critical barriers and equipment will be conducted using appropriate PPE.

3.12 DISPOSAL

- A. Asbestos wastes will be thoroughly wetted and double-bagged in appropriately labeled asbestos disposal bags. Bags will be sealed airtight while the material is still wet. Bag tops will be twisted and sealed with duct tape, then bent over and sealed again with at least three wraps of duct tape. Biological materials may be disposed of in standard construction garbage bags in enclosed roll-off containers.
- B. Additional material will not be added to bags, and bags will not be reopened after they have been sealed. Asbestos wastes will be transported by a properly licensed transporter in a covered truck and disposed of at a landfill approved for asbestos. A manifest document will be completed and signed by the Contracting Officer, the Contractor, the Transporter, and the Disposal facility. The Contractor will submit all disposal records to the Industrial Hygienist.
- C. Immediately remove hazardous rubbish from the Project Site. Place other construction debris in refuse containers at least daily. Dispose of refuse at least weekly, in a legal manner, at public or private dumping areas outside the park. Do not burn or bury refuse inside the park.
- D. Labels must be affixed to all bags, drums, or other containers containing ACWMs. The following label will be prominently displayed on the waste containers. All warning label print will be readily visible, in large bold letter-size printed on a contrasting background. Labels will contain the following information:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
DO NOT DISTURB WITHOUT PROPER TRAINING AND EQUIPMENT
DO NOT BREATHE ASBESTOS FIBERS

3.13 AIR AND WATER POLLUTION CONTROL

- A. Take all necessary reasonable measures to reduce air and water pollution by any material or equipment used during construction.
- B. Contractor personnel, building occupants, and visitors to the structures must be protected from exposure to airborne asbestos fibers.
- C. Initial exposure assessment sampling will be conducted by the Contractor's Competent Person during activities that impact ACM until a record of potential exposure during each type of activity is established.
- D. Samples will be analyzed using PCM according to the National Institute of Occupational Safety and Health (NIOSH) Counting Method 7400 for PCM.
- E. Laboratories performing analysis of air samples will be rated proficient by the American Industrial Hygiene Association (AIHA) Proficiency Analytical Testing (PAT) program.
- F. Results of the air samples will be made available to applicable personnel and will be submitted to the Industrial Hygienist within 24-hours of sample collection.
- G. Do not allow ACWM or other waste materials to be washed into the lakes or other bodies of water.
- H. The Worker decontamination shower room will contain one or more showers, as necessary, to adequately accommodate workers. Each showerhead will be supplied with hot and cold water adjustable to the tap. The shower enclosure will be constructed to prohibit leakage of any kind. The Contractor will supply and keep available at all times an adequate supply of soap, shampoo, and towels. Shower water will be drained, collected, and filtered through a system with at least 5-micron particle size collection capability. All filtered water will be stored for subsequent discharge to the site sanitary sewer. The shower unit will be constructed to ensure against any leakage of any kind and will be kept clean of all debris and ACM at all times.

3.14 REPORTS

- A. Prepare and submit a close-out report at the completion of the work.

END OF SECTION 02 82 13

SECTION 02 83 13 – REMOVAL AND DISPOSAL OF MATERIAL CONTAINING LEAD

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The buildings at Fall River Entrance Station buildings at Rocky Mountain National Park (ROMO) in Estes Park, Larimer County, Colorado (Project Site) are being demolished as part of this project. All the buildings have lead-based paint (LBP) or lead-containing paint (LCP) on several surfaces. This specification establishes required environmental controls to be used during impacts to LBP or LCP during the demolition of the Fall River Entrance Station buildings.
- B. Prior testing and analysis at the Project Site identified LCP and LBP at Fall River Entrance Station buildings as described below.
1. Kiosk 1:
 - a. White paint on the interior wooden door frame is LCP.
 - b. Light green paint on the interior wooden walls is LCP.
 - c. Bright white paint on interior wood window frames and interior wooden desk drawers is LCP.
 - d. Tan paint on exterior wooden wall framing and wooden roof framing is LCP.
 - e. Dark brown paint on exterior wood door, exterior wooden façade walls, and wooden roof soffit is LCP.
 - f. Brown paint on exterior wooden window board is LBP.
 2. Kiosk 2:
 - a. Dark tan paint on an exterior wooden door frame, exterior wooden window frames, exterior wall framing, and roof framing is LCP.
 - b. Dark brown paint on an exterior wood door, exterior wooden façade walls, a wood door threshold, and the wooden roof soffit is LCP.
 - c. Brown paint on an exterior wooden window board is LBP.
 - d. Bright white paint on an interior wooden door, an interior wood door frame, interior wooden walls, interior wooden windowsills, interior wood desk drawers, and on the interior wood ceiling is LCP.
 3. Kiosk 3:
 - a. Brown paint on an exterior wooden window board is LBP.
 - b. Dark tan paint on exterior wooden wall framing, wooden roof framing, and an exterior wood door frame is LCP.
 - c. Dark brown paint on exterior wood façade walls, an exterior door frame, an exterior door, a wooden threshold, and roof soffit is LCP.
 - d. Dark brown paint on an interior concrete baseboard is LCP.
 - e. Bright white paint on interior wooden walls, interior wood window frames, an interior wood door, an interior wood ceiling, and wooden desk drawers is LCP.
 4. Office
 - a. Bright white paint on interior wooden windowsills and interior wood vault framing is LCP.
 - b. Light green paint on interior wooden walls is LCP.
 - c. Tan paint on exterior wall framing, exterior wooden windowsills, wood roof framing, and exterior wooden window framing is LCP.

- d. Dark brown paint on the exterior wood doors, exterior wooden façade walls, and window frames is LCP.
 - e. Dark brown paint on the exterior wooden roof soffit is LBP.
- C. The Contractor will be responsible for the collection and analysis of personnel exposure samples for asbestos and lead in accordance with the U.S. Occupational Safety and Health Administration (OSHA) regulations.
- D. Applicable training will be provided by the Contractor prior to personnel performing work impacting LBP/LCP as required by applicable regulation 29 CFR 1926.62 (lead).
- E. Two hours of lead awareness training will be provided to applicable National Park Service (NPS) personnel and subcontractors working in the project facilities that contain LBP/LCP that reasonably can be expected to be impacted as part of this work.
- F. The Contractor will assume that personnel impacting LBP/LCP may be exposed to lead in excess of OSHA's action level (AL) of 30 micrograms per cubic meter over an eight-hour time-weighted average must follow the requirements of OSHA lead construction standard 29 CFR 1926.62. This applies to all construction activities that may impact LCP to the extent that dust or debris are generated. During construction activities that may generate dust or debris from existing lead-coated structural members or associated lead-containing dust impacted materials or surfaces, the Contractor will designate a Competent Person (CP) who will be present at all times. Any work impacting LCP/LBP will require the use of engineering controls to minimize dust.
- G. Any employee potentially exposed to lead levels in excess of the OSHA AL will have at a minimum two hours of lead awareness training.
- H. The Contractor is responsible for providing an independent Industrial Hygienist. The Industrial Hygienist will be coordinated with the Contracting Officer to provide waste profile sampling.
- I. The Contractor will carefully collect, containerize, transport, and dispose of regulated or hazardous wastes generated during the project, including LCP dust and debris, as well as other potentially lead-contained wastes such as disposable coveralls, respirator cartridges, etc. Since the building is being demolished, a representative sample of the waste onsite will need to be submitted for waste profiling purposes. The Government will provide temporary staging areas for waste, and the Industrial Hygienist will provide waste profile sampling.
- J. The Contractor will be responsible for the cleanup and testing of any area contaminated due to Contractor negligence at no additional cost to the NPS.

1.2 REFERENCES AND RELATED SPECIFICATIONS

- A. All work under this contract will be done in strict accordance with all applicable Federal, State, and Local regulations, standards, and codes governing lead remediation and other trade work done in conjunction with the abatement. The most recent edition of any relevant regulation, standard,

document, or code will be in effect. Where conflict among the requirements or with these specifications exists, the most stringent requirements will be utilized.

- B. Section 02 81 01: Offsite Transportation and Disposal.
- C. Landmark Environmental, Inc., *Hazardous Materials Assessment Report for Rocky Mountain National Park, Fall River Entrance Station, Estes Park, Colorado. Landmark Project No. 21115.001.001* dated 02/23/22.
- D. American Society of Safety Engineers (ASSE), *ASSE/SAFE Z9.2 Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems*, 2012.
- E. Underwriters Laboratories (UL), *UL Standard for Safety High-Efficiency Particulate, Air Filter Units*, UL 586, 2009; reprint 2017.
- F. U.S. Occupational Safety and Health Administration (OSHA), 29 CFR 1910.1025 - General Industry Standards for Lead.
- G. OSHA, 29 CFR 1926.62 – Construction Industry Standards for Lead.
- H. OSHA, 20 CFR 1910.120 – Hazardous Waste Operations and Emergency Response.
- I. OSHA, 29 CFR 1910.134 – Respiratory Protection.
- J. OSHA, 29 CFR 1910.145 – Accident Prevention.
- K. OSHA, 29 CFR 1910.2 – Medical Records.
- L. OSHA, 29 CFR 1910.38 – Emergency/Fire Prevention Programs.
- M. OSHA, 29 CFR 1910.1200 – Hazard Communication.
- N. U.S. Environmental Protection Agency (EPA), 40 CFR 260 – Hazardous Waste Management System: General.
- O. EPA, 40 CFR 261 – Identification and Listing of Hazardous Waste.
- P. EPA, 40 CFR 262 – Standards Applicable to Generators of Hazardous Waste.
- Q. EPA, 40 CFR 263 – Standards Applicable to Transporters of Hazardous Waste.
- R. U.S. Department of Transportation (US DOT), 49 CFR 171 and 172 – Hazardous Materials Regulations.
- S. National Institute for Occupational Safety and Health (NIOSH), *Certified Equipment List*.
- T. NIOSH, *Occupational Exposure Sampling Strategy 77-173*.
- U. NIOSH, *Guide to Industrial Respiratory Protection*, 87-116.

- V. ASTM International, *Collection of Settled Dust Samples Using Wipe Sampling Methods for Subsequent Lead Determination E1792*, 2003, reprinted in 2016.

1.3 DEFINITIONS

- A. AAS: Atomic absorption spectrometry, which is the laboratory method to determine lead in bulk and air samples.
- B. Authorized Person: Any person authorized by the employer and required by work duties to be present in regulated areas.
- C. Critical Barrier: One or more layers of plastic sealed over all openings into a work area or any other similarly placed physical barrier sufficient to prevent airborne dust in a work area from migrating into an adjacent area.
- D. Competent Person: The Abatement Contractor's employee who is capable of identifying existing asbestos and lead hazards in the workplace, who has the authority to take prompt corrective measures to eliminate them, and who is trained and accredited as defined in 29 CFR 1926.62. The duties of the Competent Person include but are not limited to the following: 1) controlling entry to and exit from the lead work area, 2) supervising any employee exposure monitoring required by the standards, 3) ensuring that all employees working within a work area wear the appropriate personal protective equipment and are trained in the use of appropriate methods of exposure control and decontamination, and 4) ensuring that engineering controls in use are functioning properly.
- E. Disposal Bag: A properly labeled 6-mil thick, leak-tight polyethylene bag used for containerizing and/or transporting lead waste to the disposal site.
- F. Disturbance: Activities that disturb LCP or LBP within the facility.
- G. Generator: A generator is any person, or site, whose processes and actions create hazardous waste per 40 CFR 260.10.
- H. HEPA Filter: A High-Efficiency Particulate Air (HEPA) filter capable of trapping and retaining 99.97 percent of all mono-dispersed particles (e.g., asbestos fibers) of 0.3 microns in diameter.
- I. Industrial Hygiene: An area of specialization in the field of industrial safety and health that is concerned with predicting, recognizing, assessing, controlling, and preventing environmental stressors in the workplace that can lead to sickness, disease, or other forms of impaired health.
- J. Industrial Hygienist: A person having a college or university degree(s) in engineering, chemistry, physics, medicine, or related physical or biological sciences who, by virtue of special studies and training, has acquired competence in industrial hygiene.
- K. Lead: Metallic lead, inorganic lead compounds, and origin lead soaps. Excludes other forms of organic lead compounds.

- L. Lead-Based Paint (LBP): Paint or other coatings containing at least 0.5% lead by weight or 1.0 milligrams (mg) per square centimeter.
- M. Lead-Containing Paint (LCP): Paint or other coatings containing a concentration of lead that is quantifiable through laboratory analysis.
- N. Negative Initial Exposure Assessment: A demonstration by the employer, which demonstrates that employee exposure during an operation is expected to be consistently below the permissible exposure limit (PEL) for representative eight-hour time-weighted average (TWA) samples and 30-minute excursion limit (EL) samples.
- O. Personal Monitoring: Sampling of the dust/fiber concentrations within the breathing zone of an employee.
- P. Regulated Area: An area established to demarcate areas where lead-containing dust or other contaminant concentrations in the air exceed, or there is a reasonable possibility they may exceed, the PEL or other applicable industry standards for occupational exposure limits.
- Q. Removal: All operations where lead is taken out or stripped from structures or substrates, including demolition operations.
- R. Renovation: Modifying any existing structure or portion thereof.
- S. Time-Weighted Average (TWA): The average concentration of a contaminant in the air during a specific time period.
- T. Toxicity: Toxic wastes are harmful or fatal when ingested or absorbed (e.g., containing mercury, lead, etc.). When toxic wastes are land disposed, contaminated liquid may leach from the waste and pollute groundwater.
- U. Toxicity Characteristic Leaching Procedure (TCLP): Analytical test designed to determine the mobility of both organic and inorganic analytes present in liquid, solid, and multi-phase wastes. TCLP is used to determine if a waste will carry a hazardous waste code under 40 CFR Part 261.
- V. Transporter: Hazardous waste transporters are individuals or entities that move hazardous waste from one site to another by highway, rail, water, or air per 40 CFR 260.10. This includes transporting hazardous waste from a generator's site to a facility that can recycle, treat, store, or dispose of the waste. It can also include transporting treated hazardous waste to a site for further treatment or disposal.
- W. Treatment: Treatment is defined as any method, technique, or process designed to change the physical, chemical, or biological character or composition of any hazardous waste to neutralize such waste, or to recover energy or material resources from the waste, or to render such waste non-hazardous, or less hazardous; safer to transport, store or dispose of; or amenable for recovery, amenable for storage, or reduced in volume.

- X. Visible Emissions: Any emissions potentially containing particulate or lead-containing dust material that is visually detectable without the aid of instruments.
- Y. Work Area: The area where lead-related work or removal operations are performed which is defined and/or isolated to prevent the spread of lead-containing dust or debris and entry by unauthorized personnel. The work area includes the waste load-out area.

1.4 FIELD VERIFICATION

- A. Field verify all new and existing dimensions affecting the work of this contract before ordering products.

1.5 CONSTRUCTION MATERIALS

- A. The Government will not furnish any materials for this project.

1.6 SALVAGED MATERIALS

- A. Excess salvaged materials not reinstalled in the project remain the property of the Government.
- B. Stockpile material within the rooms where the materials are recovered for reuse. If more space is required, coordinate storage location with Contracting Officer.

1.7 PROJECT SUBMITTAL REQUIREMENTS

- A. Health and Safety Related Submittals:
 1. The Contractor will submit to the Contracting Officer and Industrial Hygienist for approval a Health and Safety Plan including a Respiratory Protection Program, Medical Surveillance Program, and Accident Prevention Program.
 2. The Contractor will submit the resume and copies of professional registrations/certifications for the Contractor's employee who will act as the Competent Person for the project. The Competent Person must meet the qualifications and have the training and certifications defined by OSHA.
 3. The Contractor will submit copies of attendance records and certificates for each employee for all lead hazard awareness training as required by this Section. If requested, the Industrial Hygienist can provide lead hazard awareness training at the start of the project.
 4. The Contractor will submit proof that all employees have passed appropriate medical examinations required by OSHA for respirator use and work around lead where the PEL may be exceeded.
 5. The Contractor will submit certification that all employees have been instructed on the hazards of lead exposure, use and fitting of respirators and protective dress, use of showers, work area entry and exit procedures, work methods, and protective measures.

6. The Contractor will submit copies of current physicians' written medical opinions for all employees subject to medical surveillance requirements defined in OSHA Respiratory Protection Standards.
7. The Contractor will submit certification that each employee has been properly fitted with a specified respirator.
8. The Contractor will submit certification that HEPA vacuums, HEPA-equipped negative pressure air machines, and other equipment required to contain airborne lead dust or other particulates meets American National Standards Institute (ANSI) Z9.2 79.

B. Occupational Exposure and Environmental Sampling Plan:

1. After initial exposure monitoring, submit occupational sampling results to the Contracting Officer within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.
2. If the Contractor would like to reduce the full implementation of controls as listed under 29 CFR 1926.62, the Contractor will provide documentation. Submit a report that supports the determination to reduce the full implementation of the requirements of 29 CFR 1926.62 and supports the Lead Compliance Plan:
 - a. The initial monitoring will represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per 29 CFR 1926.62. The data will represent the worker's regular daily exposure to lead for stated work.
 - b. Submit worker exposure data gathered during the task-based trigger operations of 29 CFR 1926.62 with a complete process description. This includes manual demolition, manual scraping, manual sanding, heat gun, power tool cleaning, rivet busting, cleanup of dry expendable abrasives, abrasive blast enclosure removal, abrasive blasting, welding, cutting, and torch burning where lead-containing coatings are present.
 - c. The initial assessment will determine the requirement for further monitoring and the need to fully implement the control and protective requirements, including the lead compliance plan per 29 CFR 1926.62.

C. Lead Waste Management and Disposal Plan:

1. The Lead Waste Management and Disposal Plan will comply with applicable requirements of Federal, State, and Local hazardous waste regulations and address:
 - a. Identification and classification of wastes associated with the work.
 - b. Estimated quantities of wastes to be generated and disposed.
 - c. Names and qualifications of each Contractor who will be transporting, storing, treating, and disposing of the wastes. Include the facility location, operator, and 24-hour point of contact. Furnish two copies of EPA hazardous waste manifests.
 - d. Names and qualifications (experience and training) of personnel who will be working onsite with hazardous wastes.
 - e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.
 - f. Spill prevention, containment, and cleanup contingency measures, including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.

- g. Work plan and schedule for waste containment, removal, and disposal. Proper containment of the waste includes using acceptable waste containers (e.g., 55-gallon drums) as well as proper marking/labeling of the containers. Wastes will be cleaned up and containerized daily.
 - h. Include any process that may alter or treat waste rendering a hazardous waste non-hazardous.
 - i. Unit cost for hazardous waste disposal according to this plan.
- D. The Contractor is responsible for waste profile sampling and analysis for disposal for each waste stream.

1.8 POST-PROJECT SUBMITTAL REQUIREMENTS

- A. If required, the Contractor, on behalf of the NPS, must generate Small Quantity Generator (SQG) submittals for a one-time action based on the volumes of hazardous wastes generated during the project.
- B. After every disposal operation, provide copies of transport manifests, disposal receipts, and chain-of-custody forms for all lead waste materials removed from the site. The chain-of-custody form will include the date, address of pickup site, name and address of the Contractor, names of persons responsible for pickup, name and address of disposal site, quantity and type of hazardous waste, and type of containers used. The form will be signed by the Contractor, Contracting Officer, disposal site operator, and hauler if a private hauler is employed.
- C. Closeout Report: Prepare a closeout report with the following items:
 - 1. Description of removal and stabilization activities performed during the project.
 - 2. Description and results of occupational and environmental sampling.
 - 3. Description of cleanup activities.
 - 4. Description and results of confirmatory sampling.
 - 5. Results of waste characterization sampling.
 - 6. Chain-of-custody forms for confirmatory sampling and waste characterization sampling.
 - 7. Description of work completed, including the onsite processing of waste (if any), handling and transportation procedures, and disposal site.
 - 8. Certificates of disposal.
 - 9. Transport manifests.

1.9 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Competent Person: Submit name, address, and telephone number of the CP selected to perform responsibilities specified in the paragraph entitled "Competent Person (CP) Responsibilities." Provide documentation of construction project-related experience with implementation of OSHA's Lead in Construction standard (29 CFR 1926.62), which shows the ability to assess occupational and environmental exposure to lead, experience with the

- use of respirators, personal protective equipment, and other exposure reduction methods to protect employee health. Submit proper documentation that the CP is trained and certified in accordance with Federal, State, and Local laws.
2. Workers/Supervisors: Workers will be fully qualified and experienced in the techniques of handling and disposal of lead-painted materials. Submit training certifications and proper documentation for each worker, supervisor, and the competent person performing LBP/LCP removal activities in accordance with Federal, State, and Local laws.
 3. Analytical Laboratory: Use a laboratory participating in the EPA National Lead Laboratory Accreditation Program (NLLAP) by being accredited by either the American Association for Laboratory Accreditation (AALA) or the American Industrial Hygiene Association (AIHA), and that is successfully participating in the Environmental Lead Proficiency Analytical Testing (ELPAT) program to perform sample analysis. Laboratories selected to perform blood lead analysis will be OSHA-approved.
 4. Third-Party Industrial Hygiene Consultant: Submit the name, address, and telephone number of the third-party industrial hygiene consultant selected to perform the wipe sampling for determining concentrations of lead in dust. Submit proper documentation that the consultant is trained and certified as an inspector technician or inspector/risk assessor by the USEPA authorized State (or local) certification and accreditation program.
- B. Regulatory Requirements: Develop and implement a written Environmental Control Program covering employees, visitors, and government personnel who have the potential to be exposed to hazardous materials on the project. The program must include, but not be limited to, the following elements: a list of chemicals, labels and other forms of warning, material safety data sheets (SDS), employee information and training, procedures, chemical safety and spill response information, and subcontractor notifications.
- C. All work under this contract will be performed in strict accordance with all applicable Federal, State, and Local regulations, standards, and codes governing lead abatement and other trade work done in conjunction with the abatement. The most recent edition of any relevant regulation, standard, document, or code will be in effect. Where conflict among the requirements or with these specifications exists, the most stringent requirements will be utilized. Copies of applicable standards, regulations, and codes will be available at the worksite at all times.

PART 2 - PRODUCTS

2.1 PERSONAL PROTECTIVE EQUIPMENT

- A. Respiratory Protection:
1. Workers will be provided with personally issued, individually identified respirators that meet the required level of protection. During pre-cleaning, installation of dust/debris control critical barriers, and HEPA vacuuming activities and surface preparation activities, the Contractor will utilize full face powered air-purifying respirators with approved HEPA filter cartridges until the initial air sampling exposure assessment demonstrates that use of respirators is not required to protect personnel to air concentrations of lead dust. The

Contractor will provide workers with and require the use of respirators approved by NIOSH for lead in accordance with OSHA Standard 29 CFR 1926.62. Disposable single-use respirators or dust masks are not permitted.

2. Workers must perform positive and negative air pressure fit tests each time a respirator is worn. Powered air-purifying respirators will be tested for adequate flow as specified by the manufacturer.
3. Workers will be given a qualitative fit test in accordance with procedures detailed in OSHA 29 CFR 1926.62 for all respirators to be used. An appropriately administered quantitative fit test may be substituted for the qualitative fit test. Documentation of adequate respirator fit must be provided to the workers. Fit tests will be administered at the start of the project.
4. Persons having facial hair which may interfere with the seal of a respirator will not be allowed to enter the work area.

B. Personnel Protection for Lead-Containing Paint

1. Respiratory protection is required for workers performing LCP removal activities and during any impacts to LCP unless an initial exposure assessment (IEA) is conducted by the Contractor's Competent Person. If respiratory protection is required based on the results of the IEA, it will be provided to workers through a written respiratory protection program.
2. Disposable clothing, including head, foot, and full-body protection, will be provided in sufficient quantities and adequate sizes for all workers and authorized visitors. All personnel engaged in LBP/LCP demolition work will wear approved disposable protective clothing constructed of spun-bonded olefin or polypropylene fabrics or other material of equivalent resistance to penetration. A full-body suit is recommended in lieu of a separate set of coveralls, head covers, and shoe covers. Disposable whole-body clothing, including head covers, gloves, and shoe coverings, will be provided to and worn by all personnel in the abatement work area. If elastic sleeve closures are not provided, sleeves will be secured with duct tape to gloves. Washable footwear having a non-skid tracking surface will be provided and used by all personnel within the lead work area.
3. Contaminated clothing will be treated as lead waste and undergo the same disposal procedures utilized for lead waste.
4. Protective eyewear, gloves, rubber boots and/or other footwear will be provided as required for workers and authorized visitors. Safety shoes may be required for some activities.
5. Eating, drinking, smoking, chewing gum, or tobacco will not be allowed in the LCP work area.

2.2 EQUIPMENT

A. HEPA-equipped filtration equipment.

1. Vacuum Equipment: HEPA filtered vacuuming equipment with a filter system capable of collecting and retaining lead particulates. Filters will be 99.97 percent efficient for retaining particles 0.3 microns or larger.
2. Use of HEPA filters will not exceed manufacturers' recommended machine hours (typically 600 to 900 hours). The Contractor will use only those brands manufactured and

tested for commercial purposes. No "homemade" units will be permitted. HEPA filters will be approved by Underwriters Laboratories Method 586.

- B. If utilizing rental equipment for impact to or disposal of LCP or other lead-containing materials, notify the rental agency in writing concerning the intended use of the equipment.

2.3 PLASTIC SHEETING

- A. Six mils in thickness, and sized to minimize the frequency of joints.
- B. Polyethylene sheeting utilized for worker decontamination enclosure will be opaque white or black in color.

2.4 TAPE

- A. For use under dry and wet conditions, capable of being cleaned off surfaces without permanent marks or damage to the substratum.

2.5 CONTAINERS

- A. Air and watertight, 55-gallon metal or fiberglass drums with tightly fitting lids will be used to package the waste. The Contractor will line the drum(s) with 6 mil plastic bags and label containers in accordance with OSHA and EPA Resource Conservation and Recovery Act (RCRA) requirements. All containers will carry appropriate labels as required by OSHA, EPA, and US DOT. No container on the project site will be unlabeled as to its contents (empty or otherwise).

PART 3 - EXECUTION

3.1 DECONTAMINATION ENCLOSURE SYSTEMS

- A. Worker Decontamination
 1. During lead removal activities, a worker decontamination area will be provided.
 2. Worker decontamination enclosure systems constructed at the worksite will utilize 10-mil opaque black or white polyethylene sheeting or other acceptable materials for privacy.
 3. A cleanroom will be sized to adequately accommodate the street clothes, equipment, and supplies for the work crew. Clean disposable clothing, replacement filters for respirators, hand washing facilities, towels, and other necessary items will be provided in adequate supply at the cleanroom. Visitor center restrooms are not to be used as hygiene or wash facilities.
 4. The equipment room will be used for the storage of equipment and tools at the end of a shift after they have been decontaminated using a HEPA-filtered vacuum and/or wet cleaning techniques as appropriate. Replacement filters (in sealed containers until used) for HEPA vacuums and other applicable ventilation equipment, extra tools, containers of

coatings, and other materials and equipment that may be required during the lead removal may also be stored here as needed. A container lined with a labeled 6-mil polyethylene bag for the collection of disposable clothing will be located in this room. Contaminated footwear (e.g., rubber boots, other reusable footwear) will be stored in this area for reuse the following workday.

3.2 AIR MONITORING

- A. Air samples for lead exposure will be collected by the Contractor for a minimum of the first three days that LCP work occurs. Lead air samples will be analyzed by an independent accredited laboratory on a rush basis. The purpose of the air monitoring is to confirm the protection of workers at the point of operation and to confirm the effectiveness of emission controls established by the Contractor. The Contractor will prevent the following:
 - 1. Contamination of the areas/outside of the regulated area with airborne lead-containing dusts.
 - 2. Should any of the above occur, immediately cease activities until the fault is corrected. Do not recommence work until authorized by the Contracting Officer or Industrial Hygienist.
 - 3. Complete corrective work at no additional cost to the Government if high airborne lead-containing dust levels are identified during the Contractor's activities.

3.3 WORK PRACTICES

- A. The following sections describe protocols to be used for the various LCP removal tasks associated with this project.
- B. Manual or power sanding or grinding of lead surfaces or materials is not permitted unless tools are equipped with HEPA attachments or wet methods. The dry sanding or grinding of surfaces that contain lead is prohibited.
- C. Select lead removal processes to minimize contamination of work areas outside the control area with lead-contaminated dust or other lead-contaminated debris or waste and to ensure that unprotected personnel are not exposed to hazardous concentrations of lead.
- D. Cleanup
 - 1. Maintain surfaces of the lead control area free of accumulations of dust and debris.
 - 2. Restrict the spread of dust and debris; keep waste from being distributed over the work area.
 - 3. Do not dry sweep or use pressurized air to clean up the area. At the end of each shift and when the lead operation has been completed, clean the controlled area of visible contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area, and wet wiping the area.
 - 4. Reclean areas showing dust or debris.
 - 5. After visible dust and debris are removed, wet wipe and HEPA vacuum all surfaces in the controlled area, as applicable.

6. If adjacent areas become contaminated at any time during the work, clean, and visually inspect, all contaminated areas.
7. The Competent Person will then certify in writing that the area has been cleaned of lead contamination.

3.4 DISPOSAL

- A. If LCP/LBP waste is isolated separately from overall building debris, waste bags will be sealed airtight by the Contractor prior to placement in the drum(s). Bag tops will be twisted and sealed with duct tape, then bent over and sealed again prior to placement in the drum(s).
- B. Additional material will not be added to bags, and bags will not be reopened after they have been sealed. Lead wastes will be transported by a properly licensed transporter and disposed of at a landfill approved for lead.
- C. Labels must be affixed by the Contractor to all bags, drums, or other containers containing lead waste. The label will be prominently displayed on the waste containers. All warning label print will be readily visible, in large bold letter-size printed on a contrasting background. This only applies to waste that is considered hazardous waste per the waste profile.

3.5 AIR AND WATER POLLUTION CONTROL

- A. The Contractor will take all necessary reasonable measures to reduce air and water pollution by any material or equipment used during construction.
- B. Contractor personnel, building occupants, and visitors must be protected from exposure to airborne lead-containing dust.
- C. Lead air or dust samples will be analyzed by Atomic Absorption Spectrometry using a laboratory that is an Environmental Lead Laboratory Accreditation Program and is an American Industrial Hygiene Association accredited laboratory.
- D. The Contractor will not dispose of lead, coating wastes, or oils in storm or sanitary drains.
- E. The Contractor will not allow lead or other waste materials to be washed into streams or bodies of water.

3.6 REPORTS

- A. Prepare and submit closeout report at the completion of the work.

END OF SECTION 02 83 13

SECTION 02 84 16 - HANDLING OF OTHER REGULATED MATERIALS

PART 1 GENERAL

1.1 DESCRIPTION

- A. The work of this section consists of abatement of light ballasts that may contain polychlorinated biphenyl (PCBs) and lamps that may contain mercury to be performed during demolition of the Fall River Entrance Station buildings at Rocky Mountain National Park (ROMO) in Estes Park, Larimer County, Colorado (Project Site). Scope items and requirements for light ballasts and lamps are described in sections B through G.
- B. Other-regulated materials (ORMs) are materials that will require special handling or disposal during demolition or renovation projects that impact these materials. A survey of Regulated Building Materials (RBMs), including ORM, is contained in Landmark Environmental, Inc.'s, *Hazardous Materials Assessment Report for Rocky Mountain National Park, Fall River Entrance Station, Estes Park, Colorado. Landmark Project No. 21115.001.001* dated 2/23/22.
- C. Observed onsite during the site inspection were the following:
1. Several light ballasts and associated light bulbs on the exterior of the Kiosk buildings could not be removed to verify PCB content of ballasts or mercury content of bulbs. Contractor to review and dispose of appropriately.
 2. A smoke detector was observed in each building. The model in the office was from System Sensor. This model does not contain radioactive components at regulated levels and can be disposed of as regular construction debris/waste.
 3. A fire extinguisher was observed in each building. If these are not to be repurposed for use in another location by the National Park Service (NPS), they should be emptied, marked as empty, and disposed of as regular construction debris/waste.
 4. Computer equipment was observed in each building. If these are not to be repurposed for use in another location by NPS, they should be disposed of according to the Colorado e-Waste guidelines.
- D. Regulated lighting waste identified at the Project Site includes light bulbs and associated ballasts. The regulated light bulbs included fluorescent bulbs. The regulated lighting waste also includes ballasts suspected of containing PCBs. The U.S. Environmental Protection Agency (EPA) classifies bulbs containing concentrations of mercury greater than or equal to 0.2 milligrams per liter (mg/l) as potentially hazardous waste. The light bulbs identified at the Project Site are suspected of containing concentrations of mercury greater than 0.2 mg/l (fluorescent bulbs). Unless otherwise labeled, the fluorescent light bulbs are presumed to contain mercury concentrations greater than 0.2 mg/l and will be removed and transported for recycling.
- E. Since the buildings are being demolished, light ballasts are anticipated to be disposed. This procedure will apply to all ballasts:
1. Fluorescent light fixture ballasts that are not clearly labeled "non-PCB" will be removed and placed in U.S. Department of Transportation (DOT) approved 55-gallon drums with the accumulation date and the words "Universal Waste, PCB Ballasts" marked on the drum

labels. The drums will be transported to a Toxic Substances Control Act (TSCA)-approved landfill for disposal.

- F. Remaining waste should be disposed of as described above, in accordance with Federal, State, and Local requirements.
- G. The Contractor will be responsible for the cleanup and testing of any area contaminated due to Contractor negligence at no additional cost to the NPS.

1.2 REFERENCES AND RELATED SPECIFICATIONS

- A. All work under this contract will be done in strict accordance with all applicable Federal, State, and Local regulations, standards, and codes governing asbestos abatement and other trade work done in conjunction with the abatement. The most recent edition of any relevant regulation, standard, document, or code will be in effect. Where conflict among the requirements or with these specifications exists, the most stringent requirements will be utilized.
- B. Section 02 81 01: Offsite Transportation and Disposal
- C. Landmark Environmental, Inc., Hazardous Materials Assessment Report for Rocky Mountain National Park, Fall River Entrance Station, Estes Park, Colorado. Landmark Project No. 21115.001.001 dated 02/23/22.
- D. U.S. Occupational Safety and Health Administration (OSHA), 29 CFR 1910.145, Accident Prevention.
- E. OSHA, 29 CFR 1910.2, Medical Records.
- F. OSHA, 29 CFR 1910.38, Emergency/Fire Prevention Programs.
- G. OSHA, 29 CFR 1910.1200, Hazard Communication.
- H. U.S. Environmental Protection Agency (EPA), 40 CFR 61 Sub. A, General Provisions.
- I. EPA, 40 CFR 61 Sub. B.
- J. EPA, 40 CFR 273. Federal Universal Waste Regulations.
- K. U.S. Department of Transportation (U.S. DOT) 49 CFR 171 and 172.
- L. National Institute for Occupational Safety and Health (NIOSH), Certified Equipment List.
- M. NIOSH, Occupational Exposure Sampling Strategy 77-173.
- N. NIOSH, Guide to Industrial Respiratory Protection, 87-116.
- O. Colorado, 6 CCT 1007-3, Part 273, Colorado Hazardous Waste Regulation, Universal Waste Rule.
- P. Larimer County, Business Hazardous Waste Assistance and Education Program (BHAFE), <https://www.larimer.org/solidwaste/haz/business>, accessed 2/22/22.

1.3 DEFINITIONS

- A. Authorized Person: Any person authorized by the employer and required by work duties to be present in regulated areas.
- B. Competent Person: The Abatement Contractor's employee who is capable of identifying existing asbestos and lead hazards in the workplace, who has the authority to take prompt corrective measures to eliminate them, and who is trained and accredited as defined in 29 CFR 1926.1101 and 29 CFR 1926.62. The duties of the Competent Person include, but are not limited to, the following: 1) controlling entry to and exit from the abatement work area, 2) supervising any employee exposure monitoring required by the standards, 3) ensuring that all employees working within a work area wear the appropriate personal protective equipment and are trained in the use of appropriate methods of exposure control and decontamination, and 4) ensuring that engineering controls in use are functioning properly.
- C. Industrial Hygiene: An area of specialization in the field of industrial safety and health that is concerned with predicting, recognizing, assessing, controlling, and preventing environmental stressors in the workplace that can lead to sickness, disease, or other forms of impaired health.
- D. Industrial Hygienist: A person having a college or university degree(s) in engineering, chemistry, physics, medicine, or related physical or biological sciences who, by virtue of special studies and training, has acquired competence in industrial hygiene.
- E. Personal Monitoring: Sampling of contaminate concentrations within the breathing zone of an employee.

1.4 FIELD VERIFICATION

- A. Field verifies all new and existing dimensions affecting the work of this contract before ordering products.

1.5 CONSTRUCTION MATERIALS

- A. The government will not furnish any materials for this project.

1.6 SALVAGED MATERIALS

- A. Excess salvaged materials not reinstalled in the project will remain the property of the government.
- B. Stockpile material within the rooms where materials are recovered for reuse. If more space is required, coordinate storage location with Contracting Officer.

1.7 SUBMITTALS

- A. As specified in Sections 1.9, 1.10, and 1.11.
- B. Proof that required Federal, State, and Local permits, have been obtained.

- C. Certification that all employees have been instructed on the hazards of asbestos and lead exposure since they will be working in close proximity to areas with known asbestos and lead-containing materials.
- D. Certification that HEPA vacuums, HEPA-equipped negative pressure air machines, and other equipment required to contain airborne fibers meet ANSI Z9.2-79.
- E. Construction schedule in sufficient detail for the Industrial Hygienist to determine the duration and level of effort required for the project.
- F. Description of waste handling procedures. Include name and address of waste disposal site; name, address, and telephone number of the entity who will transport the waste; and a sample of transport manifest to be used to identify the quantity of waste removed and accepted by disposal site.
- G. After every disposal operation, provide copies of transport manifests, disposal receipts, and chain-of-custody forms for all ORM waste materials removed from the Project Site. Chain-of-custody form will include the date, address of pickup site, name and address of Contractor, names of persons responsible for pickup, name and address of disposal site, quantity of waste, and type of containers used. The form will be signed by the Contractor, the Contracting Officer, disposal site operator, and hauler if a private hauler is employed.

PART 2 -PRODUCTS

2.1 HEPA-EQUIPPED FILTRATION UNIT.

- A. Vacuum Equipment: HEPA filtered vacuuming equipment with a filter system capable of collecting and retaining dust/fibers. Filters will be 99.97 percent efficient for retaining fibers 0.3 microns or larger.

2.2 CONTAINERS

- A. Disposal drums (if applicable) will be metal with locking ring tops and inner 6-mil polyethylene liners.
- B. Stick-on warning labels, as per EPA or OSHA requirements, will be used on all disposal drums. All drums must additionally be labeled with a DOT code.

PART 3 -EXECUTION

3.1 HOUSEKEEPING

- A. Keep the project neat, orderly, and in a safe condition at all times. Use wet methods and HEPA-equipped vacuums only to collect all dust, waste, debris, etc., in areas where asbestos and/or lead dust or rodent contaminated dust are encountered. Prohibit the use of dry sweeping or vacuuming without using HEPA-equipped vacuums.

- B. Access to the work area must be restricted to "authorized persons" only. This may be accomplished by the use of properly demarcated critical barriers, securing adjacent access points, or installing barrier plastic sheeting and signs.
- C. The Contractor will verify locations of utilities prior to any environmental abatement and interior demolition work. Existing water, sewer, electrical, communications, and gas lines located within the boundaries of the environmental abatement work will be located, and non-essential utilities will be properly locked and tagged out at the limits of the environmental abatement or selective demolition work. This work will require a qualified and licensed electrician to verify safety and proper lockout.

3.2 FIRE SAFETY

The Contractor will take the following precautions against fire:

- A. The Contractor will comply fully with requirements of the Federal, State, and Local government, Owner, Owner's Representative, including stipulations as outlined below. The Contractor will maintain and enforce all regulations imposed and will be required to secure such protection as may be required. The Contractor is responsible for acquainting the local Fire Department with existing conditions.
- B. The Contractor will not impede or void the essential function of emergency fire exits while performing abatement work.
- C. At least one qualified person thoroughly familiar with fire protection and prevention will be on duty at all hours that Contractor's employees are working. This person will patrol the entire work area frequently and will have the authority to take immediate remedial action to eliminate unnecessary fire hazards.
- D. Building material storage will be limited to secure areas within the building or, where stored outside, will be kept at least ten feet away from the building. Storage areas will be approved by the Owner's Representative.
- E. Fire extinguishers: Maintain and provide approved fire extinguishers throughout all accessible areas. Placement, inspection, and maintenance of fire extinguishers will comply with 29 CFR 1926.130. The Contractor will provide at least one 20 ABC fire extinguisher for every 3,000 square feet of the work area, with a maximum distance of 100 feet between fire extinguishers. The Contractor will place (at a minimum) ABC fire extinguishers in the following locations:
 - 1. Cleanroom of personnel decontamination facility.
 - 2. Equipment room of personnel decontamination facility.
 - 3. Within the containment, at least one extinguisher for every 3,000 square feet of the work area with a maximum distance of 100 feet between fire extinguishers.
- F. Gasoline, oils, and other volatile liquids will be kept outside, to be brought into the building in quantities only as needed. Such storage will be in a well-ventilated location, removed from all open heating or lighting devices. Storage areas will be approved by the NPS.
- G. Electrical wiring for construction light and power will be a properly fused, ground fault circuit interrupter (GFCI) installed to conform to basic code requirements and maintained under the supervision of a competent electrician. This also applies to all temporary lines used by the Contractor.

3.3 DISPOSAL

- A. Fluorescent Light Fixture ballasts that are not clearly labeled "non-PCB" will be removed and placed in DOT-approved 55-gallon drums with the accumulation date and the words "Universal Waste, PCB Ballasts" marked on the drum labels. The drums will be transported to a Toxic Substances Control Act (TSCA)-approved landfill for disposal.

3.4 AIR AND WATER POLLUTION CONTROL

- A. Take all necessary reasonable measures to reduce air and water pollution by any material or equipment used during construction.
- B. Contractor personnel, building occupants, and visitors to the structures must be protected from exposures during all work activities.
- C. Results of any air samples will be made available to applicable personnel and will be submitted to the Industrial Hygienist within 24-hours of sample collection.
- D. Do not allow waste materials to be washed into the lakes or other bodies of water.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 1. Footings.
 2. Foundation walls – if exposed to view shall be integrally colored to match adjacent board formed concrete. If hidden from view, shall be gray/un-colored concrete.
 3. Walls.
 4. Slabs-on-grade – grey/uncolored at interior slabs. Note slabs/flatwork around building are integrally colored, as noted in landscape drawings.
 5. Concrete Curing
 6. Board formed, integrally colored cast-in place concrete veneer – integrally colored. Walls painted, covered in GWB, below grade, or otherwise hidden from view shall be gray/un-colored concrete.
- B. Related Sections include the following:
 1. Section 03 45 00 – Precast Architectural Concrete.
 2. Division 31 Section "Excavation and Fill" for drainage fill under slabs-on-grade.
 3. Division 32 Section "Concrete Paving" for concrete pavement and walks, including integral color.

1.03 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
 2. Submit substantiating data for each concrete mix design contemplated for use to the Contracting Officer not less than four weeks prior to first concrete placement. Data for each mix shall, as a minimum, include the following:
 - a. Mix identification designation (unique for each mix submitted).
 - b. Statement of intended use for mix.

- c. Mixture proportions and descriptions.
 - d. Wet and dry unit weight.
 - e. Water/cementitious materials ratio.
 - f. Total air content.
 - g. Design slump.
 - h. Intended method of placement in field.
3. Shrinkage testing per ASTM C157.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
1. Show all reinforcing, top and bottom profile of concrete element, supports below, and concrete walls, grade beams, joists, etc. framing into the element.
 2. Provide one continuous elevation at 1/4" scale for all walls in a common line. Show pockets and openings in shear walls, structural slabs, beams, elevation at top of beams, walls, columns, sections through all beams, pilasters and columns, and placing sequence of reinforcing for items with more than one reinforcing layer.
 3. Show locations of approved construction joints, locations of shrinkage pour strips, splices of reinforcing, type of splice used and splice location and grade of all reinforcement used.
- D. Board Form Shop Drawings: Complete details of materials and installation, including the following.
1. Form sizes.
 2. Joint locations.
 3. Installation sequence.
 4. Panel elevations.
 5. Information regarding the boards and fasteners – sizes, locations and sizes of seams between boards, shifts in plane.
- E. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Alkali-Aggregate Reactivity of Aggregates. Submit test reports indicating that fine and coarse aggregates are not “potentially reactive” based on the ASTM C295 or ASTM C1260 (or ASTM C1293) testing limits set forth in Section 5.1 of “*Guide Specification for Concrete Subject to Alkali-Silica Reactions*” (2007 Portland Cement Association). Alternately, submit ASTM C1567 test reports indicating that the combination of mix ingredients reduces the expansion due to alkali aggregate reactivity such that the mix complies with Section 5.2 of “*Guide Specification for Concrete Subject to Alkali-Silica Reactions*” (2007 Portland Cement Association). All tests for submitted reports shall have been performed within one year of the submittal date.
- F. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
 2. Admixtures.
 3. Form materials and form-release agents.
 4. Steel reinforcement and accessories.
 5. Curing compounds.
 6. Bonding agents.

7. Vapor retarders.
 8. Repair materials.
- G. Minutes of preinstallation conference.
 - H. Placement notification: Advance notification of concrete placement, submit notification at least 48 hours in advance.
 - I. Proposed location of saw cut joints not indicated on the Contract Drawings.
 - J. Curing compound data demonstrating specified moisture loss performance.
 - K. Evaporative retarder product and application data.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
 3. Concrete reinforcing steel shall be inspected by personnel experienced in concrete construction and acceptable to the Contracting Officer. Personnel currently certified as an ACI Concrete Construction Inspector will be accepted.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- F. Formwork: Design and engineering of formwork shall be the responsibility of the Contractor. Design of formwork and preparation of formwork drawings shall be under the supervision of a professional engineer registered in the state of project.
- G. Board Formed, Integrally Colored Cast-In-Place Concrete Wall Mock-Ups:
 1. Provide a minimum of three 4'x4' mock-ups.
 2. Each mock-up shall include a different mix-in concrete color additive, a minimum of three separate colors, for final color selection by Contracting Officer.
 - a. Sample Color 1: Davis San Diego Buff
 - b. Sample Color 2: Davis Omaha Tan
 - c. Sample Color 3: Davis Kailua
 3. Construct at least one month before start of other concrete work to allow concrete to fully cure before observation.

4. At location on site designated by the Contracting Officer, demonstrate methods of obtaining consistent visual appearance, including each forming and finishing condition required on Project using materials, workmanship, joint treatment, form ties, curing method, and patching techniques to be used throughout Project
 5. Retain samples of cements, sands, aggregates, and color additives used in mock-up for comparison with materials used in remaining Work.
 6. Accepted mock-up provides visual standard for work of Section.
 7. Contractor to remove when no longer required for comparison with finished work.
- H. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301 Latest Edition, "Specification for Structural Concrete," Sections 1 through 5.
 2. ACI 117 Latest Edition, "Specifications for Tolerances for Concrete Construction and Materials."
- I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Government's testing/inspection agency.
 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
 3. Minutes of the meeting shall be recorded, typed, and printed by the Contractor and distributed by him to all parties concerned within 5 days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes: Contracting Officer.

The minutes shall include a statement by the concrete contractor indicating that the proposed mix design, and placing, finishing and curing procedures can produce the concrete quality required by these specifications.
- J. Record of Work: Maintain a record listing the time and date of placement of all concrete for the structure. Retain batch tickets for all concrete. Such record shall be kept until the completion of the project and shall be available to the Contracting Officer for examination at any time.
- K. Pre-placement Inspection: Formwork installation, reinforcing steel placement, and installation of all items to be embedded or cast into concrete shall be verified by the Contractor prior to placement.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

1.07 JOB CONDITIONS

- A. Environmental Requirements:
1. Cold Weather Requirements: When depositing concrete when mean daily temperatures are below 40 degrees F., follow recommendations of ACI 306.
 2. Hot Weather Placement: When depositing concrete in hot weather, follow recommendations of ACI 305.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.02 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
 3. Form Liners: Single-use, elastomeric form liners for texturing architectural concrete with standard patterns.
 4. Colors: Integral color as determined by the mockup process. Any exposed concrete at foundation shall also be integral color. Foundation covered by grade may be standard gray.
- B. Board Formed Concrete:
1. Exposed concrete walls (exterior) shall have board-formed finish with random 6"-10" rough sawn boards, horizontally oriented. Vary widths on different rows (with a preference for larger sizes toward the bottom). No row shall be the same width as the row to either side.
 2. Board lengths shall be cut down so that vertical seams between boards shall be staggered throughout the design. Seams shall be avoided to be aligned with seams even several rows above or below each other.
 - a. On panels of 48" wide or less, butt joints between boards shall occur in at least every third row.

- b. On panels of 96" wide or less, butt joints between boards shall occur in at least two of every three rows.
 - c. Panels greater than 96" wide shall have a butt joint between boards in every row.
 - 3. Colors: Integral color as determined by the mockup process.
 - 4. Boards shall be installed tight (1/8" max. gap) and shall be set at continuous heights around corners (no board height or alignment discontinuity at corners).
 - 5. Installing board faces out of plane up to 1/2" is preferred. 50% minimum boards shall be installed out of plane with adjacent boards. This may be able to be achieved through selection of boards of different thicknesses or with normal construction tolerances, but if not, shims may need to be added.
 - 6. Fins in excess of 1/4" of the nearest planar surface (as noted above, boards shall not be coplanar) shall be removed back to within 1/4".
 - 7. Corners shall be formed as a 90 degree angle.
 - 8. Plasticizers shall be required to maximize flow and capture of texture/pattern of rough sawn wood forms.
 - 9. Contractor shall avoid repetitive patterns and shall minimize honeycombing.
 - 10. Unacceptable work (work that does not capture the board graining, that is honey-combed or that does not match the approved mock-up in finish, mix-in color and/or workmanship) shall be removed and replaced at no additional cost to the Government.
 - 11. Contractor responsible for removal of all wood and organic matter from final work.
 - C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
 - D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
 - E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 - F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1-1/2 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.
- 2.03 STEEL REINFORCEMENT
- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed Grade 40 at #3 or #4 ties or bars opted to be field bent.
- 2.04 REINFORCEMENT ACCESSORIES
- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
 - B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel

wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
- C. Mechanical Splices: Full mechanical splices shall develop in tension or compression, as required, at least 125% of the bar yield strength. Shall comply with ICC-ES Evaluation Criteria AC 133. Shall Comply with ACI 318 21.2.6.

2.05 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project. Alternate cementitious materials, when proposed to control alkali-silica reactions and tested as part of a representative complete concrete mix in accordance with ASTM C1567, may be used subject to approval.:
1. Portland Cement: ASTM C 150, Type I/II, gray unless otherwise noted. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate or better, graded. All coarse and fine aggregates shall be tested per ASTM C295 or ASTM C1260 (or ASTM C 1293) in accordance with Section 5.1 of "*Guide Specification for Concrete Subject to Alkali-Silica Reactions*" (2007 Portland Cement Association). Provide aggregates from a single source
- C. Water: ASTM C 94/C 94M and potable.

2.06 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
 7. Non-Chloride, Non-Corrosive Accelerating Admixture: The admixture shall conform to ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures.
 8. Mid-range water reducing admixture shall be EUCON X15 or EUCON MR by The Euclid Chemical Company, DARACEM or Mira Series by W. R. Grace or

POZZOLITH997 or Rheobuild 3000 by Master Builders and shall conform to ASTM C494 Type A.

2.07 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Available Products:
 - a. Axim Concrete Technologies; Cimfilm.
 - b. Burke by Edoco; BurkeFilm.
 - c. ChemMasters; Spray-Film.
 - d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film.
 - f. Euclid Chemical Company (The); Eucobar.
 - g. Kaufman Products, Inc.; Vapor Aid.
 - h. Lambert Corporation; Lambco Skin.
 - i. L&M Construction Chemicals, Inc.; E-Con.
 - j. MBT Protection and Repair, Div. of ChemRex; Confilm.
 - k. Meadows, W. R., Inc.; Sealtight Evapre.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
 - n. Sika Corporation, Inc.; SikaFilm.
 - o. Symons Corporation, a Dayton Superior Company; Finishing Aid.
 - p. Unitex; Pro-Film.
 - q. US Mix Products Company; US Spec Monofilm ER.
 - r. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating. The film must chemically break down in a four to six week period. Provide data from an Independent Laboratory indicating a maximum moisture loss of 0.30 kg/m² at 72 hours when tested in accordance with ASTM C156.
- F. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A. Have test data from an Independent Laboratory indicating a maximum moisture loss of 0.30 kg/m² at 72 hours when tested in accordance with ASTM C156.
- G. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A. Have test data from an Independent Laboratory indicating a maximum moisture loss of 0.30 kg/m² at 72 hours when tested in accordance with ASTM C156.

2.08 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C 1059, Type II, non-dispersible, acrylic emulsion or styrene butadiene.

2.09 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows
1. Fly Ash: 25 percent
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 for reinforced concrete exposed to chlorides in service percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.42.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Proportion structural normal weight concrete mixture as noted on the drawings, unless aggregates are “potentially reactive” with alkalis based on the ASTM C295 or ASTM C1260 (or ASTM C1293) testing limits of Section 5.1 of “*Guide Specification for Concrete Subject to Alkali-Silica Reactions*” (2007 Portland Cement Association). When aggregates are “potentially reactive”, compliance with Section 5.2 of “*Guide Specification for Concrete Subject to Alkali-Silica Reactions*” (2007 Portland Cement Association) must be established through ASTM C1567 testing for proposed alternate concrete mixture. Submit test reports in accordance with Part I of this specification.

2.12 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.

2.14 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder (required at all slab-on-grade locations): Multi-layer, fabric-, cord-, grid-, or aluminum reinforced polyethylene or equivalent, complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
 - 1. Accessory Products: Vapor retarder manufacturer’s recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations in vapor retarder.
 - 2. Acceptable Products:
 - a. Insulation Solutions, Inc.; Viper VaporCheck II 15-mil (Class A): www.insulationsolutions.com
 - b. Intertape Polymer Group, Inc.; VaporMaster 15: www.intertapepolymer.com
 - c. Stego Industries, LLC; Stego Wrap Vapor Barrier 15-mil (Class A): www.stegoindustries.com
 - d. Substitutions: See Section 01 60 00 – Product Requirements.
- B. Expansion Joint Filler:
 - 1. Preformed bituminous type, ASTM D1751-83.
 - 2. Preformed Sponge Rubber:
 - a. ASTM D1752, Type I.
 - b. Store sponge rubber filler at 80 degrees F. or less.
 - c. Do not store in open, or in direct rays of sun.
- C. Backer Rod
 - 1. ASTM D5249, Type 1.
 - 2. Round, flexible, extruded, closed cell polyethylene foam.
- D. Sealant (refer to Section 07 92 00 “Joint Sealants.”)
- E. Dowel Caps
 - 1. Plastic or steel

2. Caps shall correspond in size in diameter of associated steel reinforcing.

F. Curing Materials

1. Absorptive Cover: Burlap cloth made from jute, weighing approximately 9 ounces-per-square-yard., complying with AASHTO M182, Class 2, new and free of any contaminants.
2. Moisture Retaining Cover: Waterproof paper. Polyethylene film. Polyethylene-coated burlap.
3. Spray Applied Membrane Forming Liquids:
 - a. ASTM C309, Type 2, Class A.
 - b. Compatible with required finishes and coatings.
 - c. Applied at rate of 200 SF per gallon.

G. Clear Penetrating Sealer

1. Used at Interior Floor Surfaces: Material suitable for application on horizontal surfaces shall be not less than 40 percent silane, or 9 percent poly-siloxane, or shall be 20 percent siloxane.

H. Polymer Adhesives: Material suitable for use on dry or damp surface, complying with ASTM C881, for use in all structural concrete repairs.

I. Admixtures: no admixtures may be used without specific approval of Contracting Officer

J. Colored Additives for Integrally Colored Concrete:

1. Basis Design: Davis Colors manufactured by Davis Colors; www.daviscolors.com.
2. Materials
 - a. Colored additives shall contain pure, concentrated mineral pigments specially processed for mixing into concrete and complying with ASTM C979.
 - b. Mix in accordance with manufacturer's instructions. Mix until color additives are uniformly dispersed throughout mixture and disintegrating bags, if used, have disintegrated
 - c. Admixtures: Do not use calcium chloride admixtures,
 - d. Colors: Colors to be included in the three required mock-ups are as follows, selected from Davis Colors Standard and Premium Color Groups:
 - 1) "Sand Diego Buff" (#5237)
 - 2) "Omaha Tan" (#5084)
 - 3) "Kailua" (#677).
 - e. Color for site concrete color:
 - 1) "Yosemite Brown" (#641)

3. Substitutions: Comply with substitutions request procedures.

PART 3 - EXECUTION

3.01 SITE AND ENVIRONMENTAL PROCEDURES

- A. Waste Management: As specified in Section 017400, "Cleaning and Waste Management" and as follows:
1. Formwork: Reuse forms to greatest extent possible without damaging structural integrity of concrete and without damaging aesthetics of exposed concrete.
 2. Mixing Equipment: Return excess concrete to supplier; minimize water used to wash equipment
 3. Moisture Curing: Prevent water run-off.
 4. Hardened Cured Waste Concrete: May be crushed and reused as fill or as a base course for pavement.

3.02 FORMWORKS

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. GC shall provide COR with samples of forms to be used for exposed concrete walls inside building. COR shall approve and select appropriate form for smooth finish.
- D. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class C, 1/2 inch for rough-formed finished surfaces.
 - 3. The permissible irregularity is a cumulative value due to all sources of error including, but not limited to, layout, plumbness, member sizes, formwork offsets, joints, and member levelness. The permissible irregularity shall also apply between adjacent concrete surfaces on opposite sides of a construction joint, expansion joint, or shrinkage pour strip.
- E. Construct forms tight enough to prevent loss of concrete mortar.
- F. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- N. All formwork surfaces that will provide the finish surface of exposed concrete must be accepted by the Contracting Officer before depositing concrete.

3.02 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges" and with the following additional requirements:
 - a. Tolerance of embedded items: Comply with ACI 117 and the following additional requirements:
 - 1) Anchor Bolts:
 - a) Plumbness: Within + 1/16" over the projecting height of the anchor bolt.
 - 2) Embedded Plates and Weldment:
 - a) Location: +/-1" vertical, +/- 1" horizontal.
 - b. Plumb and alignment: 1/4" in 12".
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.03 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Contracting Officer.

3.04 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain concrete cover. Do not tack weld crossing reinforcing bars.
- D. Size, length, number, and placing of supports shall be sufficient to hold reinforcing in the proper position within specified tolerances during construction traffic and concrete placement.
- E. On vertical formwork, use approved bar chairs or spacers as required to maintain proper concrete cover and bar position. Do not staple or use any other metallic fastener to secure bolsters, chairs, etc. to formwork for concrete surfaces exposed to the exterior

1. Weld reinforcing bars according to AWS D1.4, where indicated.
- F. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.05 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Contracting Officer.
1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated- Locate joints beside pilasters integral with walls, near corners, and in concealed locations where possible. Locate at centerline of support or in middle third of span.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groove tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
 3. Interior Slabs-on-Grade: Unless noted otherwise on the drawings, locate construction joints on column centerlines. Locate control joints where shown on the drawings. If not shown, provide control joints at column centerlines and at intervals not more than 10 feet each way.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.06 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.07 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
- C. Board-Formed Finishes: As described in 2.02B, distribute seams in a thoughtful manner. Patch and repair defects with the same pattern/texture such that patch blends seamlessly with the surrounding board-formed finished material. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.08 FINISHING SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.
 1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.

- b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
 - 3. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-foot- long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 3/16 inch.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Contracting Officer before application.

3.09 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.10 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

- a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Moisture-retaining cover shall be inspected each day by Contractor. Any areas which do not show condensation on the underside of the cover or any slab areas which are not wet shall be immediately rewetted and the cover reapplied to prevent moisture loss.
- a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
- a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.11 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Contracting Officer. Remove and replace concrete that cannot be repaired and patched to Contracting Officer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning and that are unacceptable to the Contracting Officer. Allow the Contracting Officer to observe formed concrete surfaces immediately upon removal of forms and prior to repair of surface defects. Defects in structural concrete shall be brought to the attention of the Contracting Officer. Repair tie holes and surface defects immediately after such observation. Where the concrete surface will be textured by sandblasting or bush-hammering, repair surface defects before texturing.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Contracting Officer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template. Submit proposed repair for acceptance prior to beginning this work.
1. Repair finished surfaces containing defects that are unacceptable to the Contracting Officer. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Submit proposed repair for acceptance prior to beginning this work.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Perform structural repairs of concrete, subject to Contracting Officer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Contracting Officer's approval.

3.12 QUALITY ASSURANCE

- A. Testing and Inspecting: The contractor will engage a qualified independent testing and inspecting agency to perform tests and inspections and prepare test reports.
- B. Inspections and Tests:
 - 1. Perform inspections and tasks as noted on the drawings and in Statement of Structural Tests and Special Inspections (SST&SI) see section 01 40 00 and Appendix G: Statement of Structural Tests and Special Inspections
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 - 2. Testing Frequency: Obtain at least one composite sample for each 150 cu. yd. (114 cu. m) or fraction thereof of each concrete mix placed each day and at least one composite sample for each 5000 square feet of surface area of slabs or walls.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 3. Slump: Maximum slump varies by type of concrete, refer to schedule on structural drawings for maximum slump; ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
 - 6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - 7. Compressive-Strength Tests: ASTM C 39/C 39M; test one laboratory-cured specimen at 7 days, two at 28 days, and hold one for later testing.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 - 8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 - 9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength

and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

10. Test results shall be reported in writing to Contracting Officers, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, type of break for both 7- and 28-day tests, and air content.
 11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Contracting Officer but will not be used as sole basis for approval or rejection of concrete.
 12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Contracting Officer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Contracting Officer.
 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents and referenced standards.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

END OF SECTION

SECTION 03 45 00 - PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Architectural precast concrete sill units.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for installing connection anchors in concrete.
 - 2. Section 05 12 00 "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.

1.2 DEFINITIONS

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings:
 - 1. Detail fabrication and installation of architectural precast concrete units.
 - 2. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.
 - 3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
 - 4. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 5. Indicate relationship of architectural precast concrete units to adjacent materials.
 - 6. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
- D. Samples: Color reference samples for initial verification of design intent, for each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of three, representative of finish, color, and texture variations expected; approximately 4 by 4 by 2 inches.
- E. Delegated Design Submittal: For architectural precast concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Show governing section types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude,

and direction of loads imposed on the building structural frame from architectural precast concrete.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator .
- B. Material Certificates: For the following items:
 - 1. Admixtures.
 - 2. Structural-steel shapes and hollow structural sections.
- C. Material Test Reports: For aggregates.
- D. Preconstruction test reports.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - 1. Designated as a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units at time of bidding or designated as an APA-certified plant for production of architectural precast concrete products.
- B. Samples: After sample approval and before fabricating architectural precast concrete units, produce a minimum of one sample of a size appropriate for installation in the boardform concrete wall mockup (or stone, if Bid Option 5 selected) for review by Contracting Officer. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.
- C. Mockups: Install final sample(s) in boardform concrete (or stone, if Bid Option 5 selected) mockup to demonstrate aesthetic effects of installation and to set quality standards for materials and execution. Contracting Officer approval required to proceed.
 - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Contracting Officer specifically approves such deviations in writing.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

1.7 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground or other rehandling.

- B. Support units during shipment on nonstaining shock-absorbing material.
- C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
- D. Place stored units so identification marks are clearly visible, and units can be inspected.
- E. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.
- F. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 DESIGN AESTHETIC

- A. Profile shall be as shown on architectural drawings, with sills sloped to drain, 1/4" per foot.
- B. Front (outward facing) face shall be formed or finished with a bush hammered finish to provide aesthetic similar to stone. All other exposed faces shall be a sand finish. Concealed faces shall be a formed.
- C. Concrete shall be integrally colored to match adjacent boardform concrete or stone veneer (if Bid Option 5 selected).

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design architectural precast concrete units.
- B. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.

2.3 STAINLESS STEEL CONNECTION MATERIALS

- A. Stainless Steel Plate: ASTM A240/A240M or ASTM A666, Type 304, Type 316, or Type 201.
- B. Stainless Steel Bolts and Studs: ASTM F593, Alloy Group 1 or 2 hex-head bolts and studs; ASTM F594, Alloy Group 1 or 2 stainless steel nuts; and flat, stainless steel washers.
 - 1. Lubricate threaded parts of stainless steel bolts with an antiseize thread lubricant during assembly.

2.4 ACCESSORIES

- A. Reglets Specified Elsewhere: Specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
- B. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.5 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
- B. Limit use of fly ash and ground granulated blast-furnace slag to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.
- C. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C1218/C1218M.
- E. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures or full-depth mixtures, at fabricator's option by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi minimum.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- F. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to ASTM C642, except for boiling requirement.
- G. Lightweight Concrete Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Unit Weight: Calculated equilibrium unit weight of 115 lb/cu. ft., plus or minus 3 lb/cu. ft., according to ASTM C567.
- H. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.6 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.

- D. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
 - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A775/A775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 - 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 - 3. Place reinforcing steel and prestressing strands to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 - 4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses and specified in-place loads.
- F. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- G. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- H. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
 - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- I. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.
 - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.
- J. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- K. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that does not show in finished structure.
- L. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

- M. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Contracting Officer's approval.

2.7 FABRICATION TOLERANCES

- A. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.
- B. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.
 - 1. Inserts: Plus or minus 1/2 inch.
 - 2. Handling Devices: Plus or minus 3 inches.
 - 3. Reinforcing Steel and Welded Wire Reinforcement: Plus or minus 1/4 inch where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch.
 - 4. Reinforcing Steel Extending out of Member: Plus or minus 1/2 inch of plan dimensions.
 - 5. Location of Rustication Joints: Plus or minus 1/8 inch.
 - 6. Location of Opening within Panel: Plus or minus 1/4 inch.
 - 7. Location of Flashing Reglets: Plus or minus 1/4 inch.
 - 8. Location of Flashing Reglets at Edge of Panel: Plus or minus 1/8 inch.
 - 9. Location of Bearing Surface from End of Member: Plus or minus 1/4 inch.

2.8 FINISHES

- A. Exposed faces to be free of joint marks, grain, and other obvious defects. Corners, including false joints to be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved approved mockup and as follows:
 - 1. As-Cast Surface Finish (Concealed Surfaces): Provide surfaces to match approved sample for acceptable surface, air voids, sand streaks, and honeycomb.
 - 2. Textured (Sand) Surface Finish (Exposed Surfaces not Front Face): Impart by form liners or inserts.
 - 3. Bushhammer Finish (Front Face): Use power or hand tools to remove matrix and fracture coarse aggregates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.
- B. Do not install precast concrete units until supporting cast-in-place concrete has attained minimum allowable design compressive strength and supporting steel or other structure is structurally ready to receive loads from precast concrete units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
- B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
 - 1. Install temporary steel or plastic spacing shims as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
 - 4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch.
- C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- D. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
 - 1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
 - 2. Welds not specified to be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
 - 3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
 - 4. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.
- E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
 - 1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
 - 2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:
 - a. Turn-of-Nut: According to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts."
 - b. Calibrated Wrench: According to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts."
 - c. Twist-off Tension Control Bolt: ASTM F3125/F3125M, Grade 1852.
 - d. Direct-Tension Control Bolt: ASTM F3125/F3125M, Grade 1852.
 - 3. For slip-critical connections, use method and inspection procedure approved by Contracting Officer and coordinated with inspection agency.

3.3 ERECTION TOLERANCES

- A. Erect architectural precast concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

- B. Erect architectural precast concrete units level, plumb, square, and in alignment, without exceeding the following noncumulative erection tolerances:
1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch.
 2. Plan Location from Centerline of Steel: Plus or minus 1/2 inch.
 3. Top Elevation from Nominal Top Elevation: As follows:
 - a. Exposed Individual Panel: Plus or minus 1/4 inch.
 - b. Non-Exposed Individual Panel: Plus or minus 1/2 inch.
 - c. Exposed Panel Relative to Adjacent Panel: 1/4 inch.
 - d. Non-Exposed Panel Relative to Adjacent Panel: 1/2 inch.
 4. Support Elevation from Nominal Support Elevation: As follows:
 - a. Maximum Low: 1/2 inch.
 - b. Maximum High: 1/4 inch.
 5. Maximum Plumb Variation over the Lesser of Height of Structure or 100 Feet: 1 inch.
 6. Plumb in Any 10 Feet of Element Height: 1/4 inch.
 7. Maximum Jog in Alignment of Matching Edges: 1/4 inch.
 8. Joint Width (Governs over Joint Taper): Plus or minus 1/4 inch.
 9. Maximum Joint Taper: 3/8 inch.
 10. Joint Taper in 10 Feet: 1/4 inch.
 11. Maximum Jog in Alignment of Matching Faces: 1/4 inch.
 12. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/4 inch.
 13. Opening Height between Spandrels: Plus or minus 1/4 inch.

3.4 REPAIRS

- A. Repair architectural precast concrete units if permitted by Contracting Officer. Contracting Officer reserves the right to reject repaired units that do not comply with requirements.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 10 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780/A780M.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.5 CLEANING

- A. Clean surfaces of precast concrete units exposed to view.
- B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03 45 00

SECTION 040140.91 – STONE RESTORATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Restoration of historic stone masonry site walls and curbs.
 - 2. Restoration work includes:
 - a. Repair and treatment of historic CCCcurb and CCC steps near Big Horn Station.
 - b. Repair and treatment of salvaged CCC culvert headwall stones. (For setting and installation of new headwall stones see Section 04 34 00 “Stone Masonry”).
- B. Related Sections:
 - 1. Section 04 34 00: “Stone Masonry” for construction and reconstruction of site walls using salvaged and new stone.
 - 2. Appendix B: Mortar Analysis by Barlow Cultural Resource Consulting, LLC.

1.2 SUBMITTALS

- A. Qualifications: Submit qualifications for subcontractor firm and individuals engaged in masonry restoration work as described in Section 1.3. Submit certifications for those involved in restoration activities, mortar analysis, and restoration product formulation including documentation of experience in comparable work.
- B. Restoration Program:
 - 1. Submit a written program for masonry restoration.
 - 2. If alternative methods and materials to those indicated are proposed for any phase of restoration work, provide written description, including evidence of successful use on other, comparable projects, and program of testing to demonstrate effectiveness for use on this project.
- C. Product Data: Manufacturer's technical data for each product indicated including recommendations for their application and use; including test reports and certifications substantiating that products comply with requirements.
- D. Samples: Submit, for verification purposes, prior to mock-up erection, samples of each new exposed stone material to be used for replacing existing materials.

1.3 QUALITY ASSURANCE

- A. Restoration Specialist: Work shall be performed by a firm having not less than ten years successful experience in comparable stone restoration projects and employing personnel skilled in stone restoration processes and operations indicated.
- B. Contractor must be fully conversant with Secretary of the Interior’s “Standards for the Rehabilitation of Historic Buildings” and attendant preservation briefs associated with stone restoration and cleaning.

- C. Field-Constructed Mock-Ups:
 - 1. Prior to start of general masonry restoration, prepare following sample areas directed by Contracting Officer.
 - 2. Obtain Contracting Officer's acceptance of visual qualities before proceeding with work.
 - 3. Retain acceptable panels in undisturbed condition, suitably marked, during construction as a standard for judging completed work.
 - 4. Repointing:
 - a. Demonstrate materials, methods and colorants to be used for repointing existing stone; samples should reflect a minimum of 3 LF of repointing and should include both vertical and horizontal joint work.
 - b. New mortar color, strength, composition and texture as determined in Appendix B: Mortar Analysis.
 - 7. Patching:
 - a. Demonstrate materials and methods to be used for each type of stone surface and condition with samples approximately 2 SF in area.
 - b. Allow waiting period of duration indicated, but not less than seven calendar days, after completion of sample cleaning to permit study of sample panels for negative reactions.

- D. Sandblasting and/or use of non-proprietary acids, alkalis, powdered or liquid, will not be permitted.

1.4 PROJECT CONDITIONS

- A. Do not remove paint from stone, re-point mortar joints, repair stone or clean stone unless air temperatures are between 40 degrees F and 80 degrees F, and will remain so for at least forty-eight hours after completion of work.
- B. Cold Weather Requirements: IMIAC-recommended practices and specifications for cold weather masonry construction.
- C. Stone Patching:
 - 1. Perform preparation work one day prior.
 - 2. Patching work shall be done in morning to allow for time to monitor curing of patch.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate masonry work with other trades.
- B. Perform masonry restoration work in following sequence:
 - 1. Remove metallic elements and attachments as described below
 - 2. Perform masonry cleaning operations
 - 3. Patch stones where attachments have been removed.
 - 4. Replace deteriorated or degraded stones.
 - 5. Repoint joints.
 - 6. Perform gentle cleaning following mortaring work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Masonry:

1. Granite from local source to match existing shape, color, texture and size of the stones adjacent to the area of work (historic culvert headwalls, CCC historic curb).
 - a. Basis of Design:
Rawlins Moss
Rock Veneer
 - b. Specific stone selection for each area to be confirmed through visit to materials yard for visual confirmation.
 - c. Replacement stone may be obtained with lichen already attached, but matching of stone to existing historic material is the higher priority.
2. The following commercial source is recommended for suitable replacement:
 - a. Crystal Landscape Supplies, Loveland, Colorado.
 - b. Pioneer Landscape Centers, multiple Colorado locations.
 - b. Other sources and species may be submitted for approval and mock-up.



Example photograph of historic stone in Bighorn Ranger Station culvert headwall.

- #### B. Mortar: Mortar used in repointing to be compatible with historic in strength, texture, color and composition. *Mortar testing and analysis is provided in the Appendix B: Mortar Analysis.*
1. Portland cement.
 2. Hydrated lime.
 3. Aggregate for mortar.
 4. Water: Clean, free of oils, acids, alkalis and organic matter.
- #### C. Masonry Patching Materials:
1. Jahn Restoration Products of equivalent color and composition.
 2. An equivalent product of an approved manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Comply with recommendations of manufacturers of paint removal process and detergent cleaners for protecting building surfaces against damage from exposure to their products.
- B. Protect persons, surrounding surfaces of building, building site and all landscape from injury resulting from stone restoration work.

- C. Prevent chemical cleaning and paint removal solutions and from coming into contact with pedestrians, motor vehicles, landscaping, buildings and other surfaces which could be injured by such contact.
- D. Do no stone cleaning or paint removal during winds of sufficient force to spread cleaning solutions to unprotected surfaces.
- E. Dispose of run-off from cleaning and paint removal operations nightly by legal means in accordance with local codes and in a manner which prevents soil erosion, undermining of paving and foundations, damage to landscaping and water penetration into building interiors.
- F. Erect temporary protection covers over pedestrian walkways and at points of entrance and exit for persons and vehicles which must remain in operation during course of stone restoration work.
- G. Protect unpainted metal and wood from contact with paint removal products and detergent cleaners.
- H. Prevent grout or mortar used in repointing and repair work from staining face of surrounding stone and other surfaces.
- I. Remove immediately grout and mortar in contact with exposed stone and other surfaces.
- J. Protect sills, ledges, projections and sidewalks from mortar droppings.
- K. Metallic Elements Removal
 - 1. Remove all metallic elements from stone; those which cannot be removed manually should be carefully core-drilled out, removing metal and as little original stone as possible.
 - 2. Clean, remove, or abrade any loose or rough stone material with a non-ferrous abrasive type grinding tool fitted with appropriate stone grinding tip so that patch in-fill will not have a feathered edge.

3.2 MORTAR MIXING

- A. Measurement and Mixing:
 - 1. Measure cementitious and aggregate material in a dry condition by volume or equivalent weight.
 - 2. Do not measure by shovel, use known measure.
 - 3. Mix materials in a clean mechanical batch mixer.
- B. Mixing Pointing Mortar:
 - 1. Thoroughly mix cementitious and aggregate materials together before adding any water.
 - 2. Then mix again adding only enough water to produce a damp, unworkable mix which will retain its form when pressed into a ball.
 - 3. Maintain mortar in this dampened condition for one to two hours.
 - 4. Add remaining water in small portions until mortar of desired consistency is reached.
 - 5. Use mortar within thirty minutes of final mixing; do not re-temper or use partially hardened material.
- C. Do not use admixtures of any kind in matching mortar.

3.3 PATCHING DETERIORATED STONE

A. Crack Patching and Repair:

1. Repair procedures presented below address aesthetic repair of non-structural and non-active loss, chips, cracks, and areas of previous patching.
2. Cracks 1/16 Inch to 1/4 Inch in Width, Stable Unit Elements:
 - a. Cut along full length of crack with grinding tool fitted with appropriate stone grinding tip to widen crack to approximately 3/16 inch wide by 1/2 inch deep.
 - b. Areas to be cut should be interior “dovetailed” or back-cut to provide positive anchor keying wherever possible.
 - c. Clean out all residual dust along full length of crack with compressed air, followed by degreasing solution (one part water, one part ethyl alcohol), followed by low-pressure rinse and pre-wet as appropriate to materials employed.
 - d. Dam crack with water soluble clay to prevent leakage of grout.
 - e. Use clay to keep grout back from exterior surface a minimum 1/4 inch.
 - f. Inject crack with non-shrink injection grout.
 - g. Following cure of injection grout, apply cementitious compound sculpted to match original profile.

3. Stone Patching:

- a. Cut straight back around full perimeter and area of chip to a minimum depth of 1/2 inch with grinding tool fitted with appropriate stone grinding tip so that patch in-fill shall not have a feathered edge.
- b. Make cut as straight and even as possible, following general line of loss.
- c. At this perimeter provide interior “dovetailed” or under-cuts to provide positive anchor keying for patching mortar.
- d. Remove any residual dust with a pressure water wash.
- e. Clean, remove, or abrade any loose or rough material with a non-ferrous abrasive.
- f. Scarify surface to assure adhesion of repair.
- g. Clean and pre-wet surface as appropriate to receive repair.
- h. Apply restoration mortar to repair area.
- i. Sculpt compound to match original profiles, give finished patch wet-struck finish.
- j. Apply restoration mortar in accordance with manufacturer’s recommended application procedures and under manufacturer’s required safety and environmental conditions
- k. Following cure, mechanically or chemically expose aggregate by removing latence from surface of patch.
- l. Wash any remaining residue from surface with clean water.

3.4 JOINT REPOINTING

A. Repointing Stone - Preparation:

1. Rake out deteriorated mortar from joints to depths equal to two-and-one-half times their widths, but not less than 1/2 inch nor less than that required to expose sound, un-weathered mortar. Deteriorated mortar joints are joints which are no longer providing weather protection and/or have lost bond to stone by cracks which are greater than hair-line, or mortar has deteriorated greater than 1/4 inch or existing mortar crumbles to touch.
2. Rake out also incompatible mortar from joints to depths equal to two-and-one-half times their widths, but not less than 1/2 inch nor less than that required to expose sound, un-weathered and historically compatible mortar. Incompatible mortar is that which does not match historic in color, strength, composition or tooling.

3. Remove mortar from stone surfaces within raked-out joints to provide reveals with square backs and to expose stone for contact with pointing mortar.
4. Brush, vacuum or flush joints to remove dirt and loose debris.
5. Cut out old, deteriorated mortar by hand with chisel and mallet. Do not spall edges of stones or widen joints.
6. Power operated rotary hand saws and grinders may be permitted, but only on horizontal joints (a pneumatic chisel may be allowed on vertical joints to facilitate efficiency) and only on specific written approval of Contracting Officer based on submission by Contractor of a satisfactory quality control program and demonstrated ability of operators to use tools without damage to stone.

B. Repointing Stone - Execution:

1. Rinse stone joint surfaces with water to remove any dust and mortar particles.
2. Time application of rinsing so that, at time of pointing, excess water has evaporated or run off, and joint surfaces are damp, but free of standing water.
3. Apply first layer of pointing mortar to areas where existing mortar was removed to depths greater than surrounding areas.
4. Apply in layers not greater than 3/8 inch until a uniform depth is formed.
5. Compact each layer thoroughly and allow to become thumbprint-hard before applying next layer.
6. After joints have been filled to a uniform depth, place remaining pointing mortar in three layers with each of first and second layers filling approximately two-fifths of joint depth and allow to become thumbprint hard before applying next layer.
7. Where existing stones have rounded edges recess final layer slightly from face. Match tooling profile of existing mortar.
8. Take care not to spread mortar over edges onto exposed stone surfaces, or to feather edge mortar.
9. When mortar is thumbprint hard, tool joints to match original appearance of joints.
10. Remove excess mortar from edge of joint by brushing.
11. Cure mortar by maintaining in a damp condition for not less than seventy-two hours.
12. Where repointing work precedes cleaning of existing stone, allow mortar to harden not less than thirty days before beginning cleaning work.

3.5 CLEANING STONE FOLLOWING RESTORATION WORK

- A. Before mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter using soft brushes/cloths and clean water, spray applied at low pressure.
 1. Avoid damaging or removing lichen and moss.
- B. Heat water to temperature of 140 to 180 degrees F.
- C. Water and gentle brushing is the preferred method for cleaning. If further effort is absolutely necessary, consult with the Contracting Officer for direction on whether other cleaning efforts will be permitted or if further cleaning will not be needed.

END OF SECTION 040140.91

SECTION 04 34 00 – STONE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Work includes all new stone veneer work in site retaining walls, sign bases (Monument Sign in Bid Option 3, VMS Sign in Bid Option 4), stone veneer base for building in Bid Option 5 and Fall River culvert walls.
 - a. Intent of Bid Option 5 is to provide a stone base to the new office building and kiosks that matches the color, scale (ie. stone size and proportion), coursing, and setting (mortar color, widths, and relationship to the stone) as the foundations of the Bighorn Ranger Station, but in a veneer stone. This will require a skilled stone mason (qualifications below) and the incorporation of larger split boulders at the base of the office building (no space available for this at the kiosks).
2. Work also includes resetting of salvaged stone for the following: Historic CCC Culvert Stone Headwalls, Historic CCC Stone Curb

B. This Section includes the following:

1. Section 01 32 33 – Photographic Documentation
2. Section 01 33 00 - Submittal Procedures
3. Section 01 35 91 – Historic Preservation Treatment Procedures
4. Section 02 41 13 - Selective Site Demolition
5. Section 03 30 00 - Cast in Place Concrete
6. Section 31 12 00 - Earth Moving
7. Section 32 13 13 - Concrete Paving
8. Section 04 01 40.91 - Stone Restoration for material selection and repair of existing stone features as indicated on the Drawings.

1.2 QUALITY ASSURANCE

- A. Qualifications: Masonry work from repair and reconstruction of existing masonry to new stone features shall be executed by professional stone masons with a minimum successful experience of 10 years in the type and size of projects comparable to the Work, including thick stone veneer and load bearing stone masonry.
- B. Testing Of Mortar Mixes: Perform tests of mortar mixes to ensure conformance with requirements specified and to ensure mortar will not produce efflorescence. If mixes do not conform with requirements, resubmit for further testing.
- C. Coordination: Advise installers of other work relating to stone masonry concerning installation of inserts, anchors, or other materials which are to be incorporated into or used by stonework.

Coordinate location and placement of related work to ensure proper installation of stone veneer and stone construction. Coordinate masonry work with other trades.

D. Testing and Inspections

1. Inspections: Inspections of subgrade, reinforcing, masonry construction and backfill will be as noted in Division 01 including Contractor's schedule of inspections for wall work and scheduling of individual inspections with a minimum of 14 days notice.
2. Geotechnical Inspections/Testing: Contractor shall engage a qualified testing and inspection agency as noted in Division 01 to inspect subgrade, perform tests and submit reports for all wall subgrade work.
3. Mortar Samples: Test (3) areas of mortar at Bighorn Ranger Station to determine composition and strength. Mortar used in repointing to match existing in strength, texture and composition.

1.3 SUBMITTALS

A. As specified in Section 01 33 23 – Submittal Procedures.

B. Stone Samples: Submit, for verification purposes, prior to mock-up erection, samples of each new exposed stone material to be used for replacing existing materials and for new construction. Contractor shall provide stone samples representative of the blend. Obtain approval of stone samples by CO prior to deconstruction and installation.

1. Submit at least six samples of each specified stone type to define the range of color, texture, marking, and tooling.
2. Samples shall be not less than 12" x 6" x 4" (LxWxH) in measurement. Samples shall show the sawn condition, tooled condition, guillotine condition, texture, finish, strata, and anticipated range of color. Show extreme ranges of color, texture, finish, and quality in each set.
3. One set of samples approved by the CO shall be retained by the Government; the other returned to the Contractor for guidance.
4. Natural stone materials may have variations in color and other characteristics. Depending on stone selected and quantity required a range of mock-ups shall be used to further define the characteristics of the materials.
5. Stone Integrity: The Contractor shall guarantee that the stone selected for the project will withstand all climatic and inherent pressures, abuses, and wear associated with this project.

C. Stone Supplier: Submit name, address and phone number of supplier.

D. Manufacturer's Literature and Product Data: submit manufacturer's printed instructions and data for each product; including applicable temperature ranges, technical data for each product indicated including recommendations for their application and use; including test reports and certifications substantiating that products comply with requirements.

1. Certificates: Furnish an affidavit from supplier certifying materials and products delivered meet requirements specified.
2. Joint reinforcement, anchors, and ties: Submit manufacturer's data.
3. Admixtures: Describe content, properties and recommended dosage.

4. Setting and Grouting Materials: submit separate statement or notation on package labels indicating compliance with specified requirements and suitability for intended use. Submit setting and joint sand mortar color additive for approval by Contracting Officer.
 5. Manufacturer's Maintenance Instructions: submit supplier's recommended cleaning and stain removal methods and cleaning materials.
- E. Construction Procedures: proposed hot and cold weather construction procedures. Description of grouting methods for cavity wall grouting and stone veneer grouting.
- F. Shop Drawings:
1. Contractor shall submit shop drawings for all existing stone features and new construction and as indicated on the Drawings for CO approval prior to deconstruction, repair, reconstruction and installation or new construction.
 2. If alternative methods and materials to those indicated are proposed for any portion of the work, submit recommendations in the shop drawings, including evidence of successful use on other, comparable projects, and program of testing to demonstrate effectiveness for use on this project.
- G. Mortar Samples: Submit mortar samples for Bighorn Ranger Station base masonry.
- H. Pointing and Repointing Samples:
1. Demonstrate materials, methods and colorants to be used for repointing existing stone repair and pointing new stone construction; samples should reflect a minimum of 3 LF of repointing and should include both vertical and horizontal joint work.
 2. New mortar color, strength, composition and texture as determined by mortar testing shall match strength characteristics of new, existing or salvaged stone to be used construction, reconstruction or repair.
 3. Field mock-up with mortar sample shall be reviewed and approved by CO prior to installation.
- I. Sandblasting and/or use of non-proprietary acids, alkalis, powdered or liquid, will not be permitted.
- J. Reference Standards: Comply with the requirements of the reference standards noted herein, except where more stringent requirements are described herein or otherwise required by the Contract Documents.

1.4 DEFINITIONS

- A. The following are definitions for the stone masonry terminology used in this specification and on the Drawings.
1. Arris: The sharp edge or exterior corner formed by the meeting of two surfaces, whether planed or curved.
 2. Bedding, Bed, or Bed Joint: a horizontal joint, mortared or dry laid, between two adjacent stones.
 - a. The top or bottom horizontal surface of a piece, which is covered when the piece is set in place.

- b. A filled or open space extending horizontally between adjacent pieces set in place.
- 3. Capstone: the uppermost stone course at stone walls.
- 4. Cavity Wall: a masonry wall with face wythes of CMU and/or stone masonry which are tied with metal ties that extend through a fully grouted cavity.
- 5. Depth: the dimension from the exposed face of a stone to the opposite, unexposed face, within a wall, veneered or otherwise.
- 6. Face: the exposed major surface of the stone piece with its specified finish.
- 7. Face-bedded: the practice of placing the bedding plane of the stone parallel to the surface plane of the wall.
- 8. Head: the exposed surface of the jointed end of any given piece whose gauged dimension is not more than the minimum thickness of the material specified.
- 9. Height: the vertical dimension of the exposed face of a stone within a wall, veneered or otherwise.
- 10. Honed: dull sheen, without reflections.
- 11. Joint: a vertical joint, mortared or dry laid, between two adjacent stones. The end or side surface of a piece which is covered when the piece is set in place. A filled or open space extending vertically between adjacent pieces set in place.
- 12. Jumper: a stone that extends up through horizontal bedding planes. These stones may be square or rectangular in shape.
- 13. Kerf: slot cut into edge of sandstone or granite piece with saw blade for insertion of anchor.
- 14. Polished: mirror gloss, with sharp reflections.
- 15. Quirk Mitre: the right-angle exposure from the face of the jointed edge whose dimension is a recommended minimum of 1/4 inch. Polished finish on the quirk miter when the face is polished; honed when the face is honed; and diamond finish when the face is thermal.
- 16. Rebated Kerf: additional cut that counter sinks kerf from back edge of kerf to back edge of stone piece for the purpose of additional anchor clearance. This is not a gauged cut, and if used for a bearing surface, it must be shimmed to allow for tolerance in cut.
- 17. Sawn: relatively plane surface with texture ranging from wire sawn, a close approximation of rubbed finish, to shot sawn, with scorings 3/32-inch in depth. Gang saws produce parallel scorings, rotary or circular saws make circular scorings. Shot-sawn surfaces should be cleaned to remove all rust stains.
- 18. Seam: a crack or fissure in a rough quarry block.
- 19. Start: the beginning of a crack, caused by quarrying, fabrication, or handling.
- 20. Stone Veneer: non-structural facing of stone secured to a concrete backing and supported by mechanical fasteners attached to the backing.
- 21. Thermal: finish produced by application of high temperature flame to the surface. Large surfaces may have shadow lines caused by overlapping of the torch.
- 22. Width: the horizontal dimension of the exposed face of a stone within a wall, veneered or otherwise.

1.5 MOCK-UPS

A. Field-Constructed Mock-Ups:

- 1. Prior to start of general masonry construction, prepare following field mock-ups in locations noted or where directed by Contracting Officer.
- 2. Obtain Contracting Officer's acceptance of field mock-ups for visual qualities and approval of construction for each mock-up before proceeding with work.

B. Field Constructed Mock-Up Panel – Reconstructed CCC Culvert Headwalls

1. Erect on actual location of work, prior to shipping of bulk materials, mock-up of sample wall panel for the approval of Contracting Officer. If the mock-up is not accepted it shall be dismantled and reconstructed in place. Obtain approval of shop drawings prior to deconstruction and mock-up.
2. Sample wall panel for wall reconstruction shall be a continuous 6 feet long straight section in the indicated profile, height with stone coursing, joints and stone caps to match existing. Sample panel shall be built of materials salvaged from the existing historic culvert wall and as indicated on Drawings. Sample panel shall be built after approval of shop drawings and after deconstruction of the existing wall.
3. Sample wall panel for infill sections of wall shall be a continuous 6 feet straight section in the indicated profile. Sample shall be built of materials salvaged from the existing wall and of new stone as approved by CO. Sample panel shall be built after approval of shop drawings and after deconstruction of the existing wall. Backup wall materials for the sample shall be as indicated. Sample panel shall match existing stone wall as indicated on the Drawings.
4. Sample wall panels shall contain full color range, texture, bond, mortar joints and workmanship of materials and shall include all anchoring devices, weeps, mortar, etc., as specified and indicated.
5. Panel mock-ups and approval shall be completed prior to continuation of work on the wall. Approved panels shall become the standard of comparison for future work, and shall remain in place as part of new wall reconstruction if accepted by CO. If not accepted sample panel shall be deconstructed and rebuilt until a suitable sample panel is accepted.

C. Field Constructed Mock Up Panel – Stone Veneer Retaining Walls

1. Erect, on actual location of work, prior to shipping of bulk materials, sample of wall panel for approval by Contracting Officer. If the mock-up is not accepted it shall be dismantled and reconstructed in place. Obtain approval of shop drawings prior to deconstruction and mock-up.
2. Sample mock-up wall shall be a continuous stone curb 4 feet long by typical full height.
3. Mock up shall contain full color range, texture, joints and workmanship of materials and shall include all stone sizes, joints, weeps, etc., as specified and indicated.
4. Mock up and approval shall be completed prior to continuation of work on stone edges. Approved mock ups shall become the standard of comparison for future work, and shall remain in place until completion of all stone edge work.

D. Field Constructed Mock Up Panel – Stone Veneer Building Walls (Bid Option 5)

1. Erect, on project construction site, prior to shipping of bulk materials, sample of wall panel for approval by Contracting Officer. If the mock-up is not accepted it shall be dismantled and reconstructed in place. Obtain approval of shop drawings prior to deconstruction and mock-up.
2. Sample mock-up wall shall be a full corner (4 foot minimum on both legs of the “L”) of the office building wall, including stone veneer and mortar on backup framing and insulation, precast cap, flashing, and cementitious siding. As this is a corner detail, mockup wall shall include split boulder detail at base of corner.
3. Mock up shall contain full color range, texture, joints and workmanship of materials and shall include all stone sizes, joints, weeps, etc., as specified and indicated.

4. Mock up and approval shall be completed prior to work on building veneer. Approved mock ups shall become the standard of comparison for future work, and shall remain in place until completion of all stone edge work.
5. Mock up shall not be included in the final work product unless previously approved by the Contracting Officer.

1.6 SHOP DRAWINGS

- A. Contractor shall submit shop drawings for existing stone features repair, reconstruction and new stone construction as indicated on Drawings for CO approval prior to deconstruction, repair or reconstruction and prior to installation or new construction start up.
- B. Shop Drawings shall indicate all bedding, bonding, jointing, and anchoring details, relationship to adjoining construction, and the general dimensions and ranges of stones. Indicate field cutting which may be required, as well as method of attachment. Verify dimensions and elevations of adjacent work on-site by accurate field measurement prior to preparation of shop drawings. Coordinate with structural concrete work and other trades where needed to meet intent of Drawings and specifications.
- C. No final sizing or finishing shall be done until the shop drawings for that part of the Work have been approved.

1.7 PRODUCT HANDLING

- A. Packaged Materials: deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from weather, moisture, deterioration, and contamination during delivery, installation, and site storage. Store cementitious materials off the ground, under cover, and in a dry location.
 1. Deliver natural stone materials on pallets or other suitable means of packing to preclude shifting during handling and transport. Damage to naturally weathered faces will be cause for rejection of stone.
 2. Storage And Protection: Store bulk materials such as sand and aggregate in segregated stockpiles in a manner to prevent contamination by mud, dirt and other foreign materials.
- B. Storage of new stone veneer only: store where directed by Contracting Officer.
 1. Protect stone during storage and construction against moisture, soiling, staining, and physical damage.
 2. Handling: Handle stone to prevent chipping, breakage, soiling, or other damage. Do not use pinch or wrecking bars without protecting edges of stone with wood or other rigid materials. Lift with wide-belt type slings whenever possible; do not use wire rope or ropes containing tar or other substances which cause staining. If required, use wood rollers and provide cushion at end of wood pieces.
 3. Storage: Store stone on wood skids or pallets, covered with non-staining, waterproof membrane. Wood in contact with stone must be low in resins and of species free of tannin. Place and stack skids and stones to distribute weight evenly and to prevent breakage of cracking of stones.
 4. Replace damaged units with new as directed by CO.

- C. Drill holes or other marks of handling will not be permitted in exposed face of work.

1.8 PROJECT/SITE CONDITIONS

- A. Do not place veneer or stone for walls when outside air temperature is below 40 degrees F unless approved means are provided to heat materials, protect work from cold and frost, and ensure that mortar and grout will cure without freezing. Conform to “Recommended Practices and Guide Specifications for Cold Weather Masonry Construction” by IMI. Provide the following minimum protection procedures when temperature falls below 40 degrees F.
 - 1. Remove any ice or snow formed on stonework bed by carefully applying heat until top surface is dry to touch. Remove setting bed and stonework determined to be frozen or damaged by freezing conditions.
 - 2. Do not use frozen materials or materials mixed or coated with ice or frost. Do not use salt to thaw ice in anchor holes or slots. Do not lower the freezing point of mortar by use of admixtures or anti-freeze agents, and do not use calcium chloride in mortar or grout.
 - 3. When mean daily air temperature is from 40 degrees F to 32 degrees F, protect stone work from rain or snow for at least 24 hours by covering with weather-resistive membrane.
 - 4. When mean daily air temperature is below 32 degrees F, maintain stonework temperature above 32 degrees F for at least 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps, or other acceptable methods.
 - 5. Cold Weather Requirements: IMIAC-recommended practices and specifications for cold weather masonry construction.
- B. Environmental requirements for mortared and dry laid stone are as follows:
 - 1. Complying with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer’s printed recommendations.
- C. Review existing conditions prior to work as follows:
 - 1. Utilities: Determine location of underground utilities. Perform work in a manner to avoid possible damage. Hand excavate, as required.
 - 2. Excavation: Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned. When conditions detrimental to Work are encountered, such as disturbed protection board, unprotected waterproofing, adverse drainage conditions, incomplete construction or obstructions, notify Contracting Officer before proceeding.

1.9 CLOSEOUT SUBMITTAL

- A. In accordance with Section 01 77 00, furnish 400 square feet of various sizes, color, and texture of stone used in project. No piece is to be of less dimension than the smallest face stone used on the project.

1.10 WARRANTY AND REPLACEMENT

- A. Warranty Period: As stated in Division 01.
- B. Warranty all stone work against defects, inferior workmanship, or failure of any kind due to any cause including vandalism. The following warranty conditions apply:
 - 1. The Contractor, by commencing the work of this Section, assumes overall responsibility, as part of his warranty of the work, to assure that all assemblies, components, and parts shown or required within the Work of the Section, comply with contract documents. The contractor shall further warrant:
 - a. That all components, specified or required to satisfactorily complete the installation, are compatible with each other and with the conditions of installation and expected use.
 - b. The overall effective integration and correctness of individual parts and the whole of the system.
 - c. Compatibility with adjoining existing substrates, materials, and work by other trades.
 - d. There shall be no material failure due to improper installation of stone walls, materials are to fully perform to their normal life expectancy.
 - 2. With the accompaniment and approval of the CO, inspect work within one month of placement; flag and reset any units that are out of plane, cracked, chipped, or rocking. Reset any units or areas that have settled excessively. Replace all cracked, damaged, failed, or spalled stones and reset any unit or area that has settled or heaved out of plane.
 - 3. All expenses incurred in the replacements shall be borne by the Contractor.
 - 4. Make replacements within seven days of notification by Government.

PART 2 - PRODUCTS

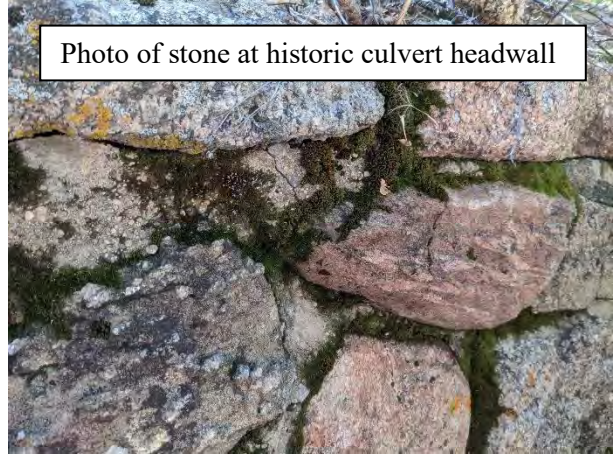
2.1 STONE

- A. Stone Sources:



- 1. Acceptable stone sources include salvaged stone from deconstruction of existing stone features and commercial stone sources.
- 2. Stone from local source to match existing shape, color, texture and size.
 - a. Basis of Estimate: Moss Rock Veneer
 - b. Consider Basis of Estimate as a best guess as availability of matching stone was not able to be guaranteed at time of design.
 - c. Specific stone selection to be through visit to materials yard for visual confirmation.

3. Two types of stone are anticipated:
 - a. Building Veneer Stone – to match stone at base of Bighorn Ranger Station.
 - b. New Stone at Historic Culvert – to match stone of historic culvert headwall.
 - c. Research has been attempted to find matching stone and the basis of estimate stone noted above is the closest we've come.
 - d. Contractor shall anticipate additional research to source the appropriate stone as the basis of estimate stone is only marginally matching and may require select use of closest matching stone, leading to possible surplus/waste veneer that does not match.
4. Sources and species may be submitted for approval by the CO. New stone shall be from local / regional quarry and stone shall match existing stone.
5. Stone shall be sound, hard, well-shaped, clean, durable, and free from structural defects and seams, iron rust, and dirt. Sorting, collection, storage and transportation of stone materials are the responsibility of the Contractor as is coordinating with the sub-contractors. Cutting, splitting, tooling and installing stone as required, is the responsibility of the contractor and sub-contractors. All chips and waste must be returned hauled off and disposed of legally as per Division 01.
6. Contractor shall provide samples, shop drawings, and mock-ups as indicated on the Drawings and in this Section.



B. Dimensions General:

1. Veneer:
 - a. Minimum depth of face stone in cavity walls and stone veneer is 4 inches as indicated on the Drawings and as approved by CO.
 - b. Stone thickness on stone veneer walls changes from base to top as indicated on the Drawings.
 2. Base Boulders:
 - a. Minimum depth shall be 11" from the face of the insulation/wall backup. Depth includes 1" grouted space between stone and wall.
 - b. Boulder base shall be minimum 25% larger than largest adjacent stones. See also Drawings.
 3. Stone shall be sized and shaped to be of a matching size, proportion, and layout as seen on Bighorn Ranger Station base.
 4. Base Boulders shall be split at back to allow flat face to be installed next to backup wall, with boulder providing a heavy base at outside corners of office building.
 - a. Boulder base extends 4 feet minimum from outside corners.
- C. Stone meeting the specified requirements, but unsuitable for use in the exposed face, may be used in the foundation course below finished grade to within 3 inches of finished grade.

D. CCC Culvert Headwall Stone Wall Pattern:

1. As indicated in the Drawings: Stone masonry laid up in a natural horizontal random pattern, roughly coursed, with a mixture of somewhat rectilinear and somewhat square stones. Largest stones shall be placed predominantly near the bottom and corners, with a variety of sizes spread evenly throughout the wall, diminishing in size as they near the top.
2. Stone pattern, joint sizes, tooling and range of stone sizes shall match adjacent stone work indicated on the Drawings and as directed in the field by the CO.

E. Stone Veneer Wall Pattern:

1. Shaped and tooled stone masonry veneer laid up in a horizontal random pattern, roughly coursed, with a mixture of somewhat rectilinear and somewhat squarer stones. Largest stones shall be placed predominantly near the bottom and corners, with a variety of sizes spread evenly throughout the wall. Mix and pattern shall be as indicated on the Drawings.
2. Stone pattern, joint sizes, tooling and range of stones sizes shall match stonework base of Bighorn Ranger Station and as directed in the field by the CO.

2.2 MORTAR (For Stone Veneer Only, Mortar on Historic Walls shall be per Section 04 01 40.91 - Stone Restoration)

- A. General: provide mortar of uniform strength and uniform color for masonry. Use same mix throughout work. Use of salts or chemicals to prevent freezing is prohibited. Other additives are not permitted unless specified herein.
- B. Mortar Mix and Strength: provide mortar which complies with testing as indicated in this Section and with ASTM C270, Type S.
- C. Mortar Composition to be determined by mortar testing at Bighorn Ranger Station. Mortar shall match existing mortar in composition and hardness and comply with ASTM C270.
 1. Mortar Testing in Appendix B is for the Historic Culvert Headwalls and CCC Historic Curbs only.
 2. This section to be confirmed and completed following results of preliminary mortar testing. Proceed only after mortar testing is complete and characteristics of the following are confirmed and accepted by Contracting Officer.
 - a. Portland Cement: Provide testing. Comply with ASTM C150, Type 1 all of same color, containing less than 1.03% of water-soluble alkali as determined by ASTM C114. Type III cement may be used for cold weather construction, with the Contracting Officer's prior approval.
 - b. Hydrated lime: ASTM C207, Type S. Confirm with testing and proceed upon acceptance by CO.
 - c. Aggregate for mortar: Select materials that produces minimum efflorescence, Light-colored natural or manufactured sand conforming to the requirements of ASTM C144, from one source and of one color and gradation. Confirm with testing and proceed upon acceptance by CO.
- D. For new veneer walls, match color and texture and installation of existing mortar at Bighorn Ranger Station.

- E. For Historic Culvert Headwalls and CCC Historic Curbs, match color and texture and installation of existing mortar at headwalls and curb.
- F. Water: Clean, free of oils, acids, alkalis and organic matter.
- G. Color Additives: Provide mineral pigment color additives as required to achieve mortar color selected by CO. Mix shall be dry enough so that mortar does not blend on face of stone at time of installation.

2.3 GROUT

- A. General: provide grout which complies with ASTM C476-95, Type Coarse, Type I or II Portland cement. Minimum compressive strength, 2000 psi per ASTM C1019-89a. Design slump, 9 inches plus or minus 1 inch per ASTM C143-90a.
- B. Fine Grout (for clear spaces 3" or smaller): mix by volume 1 part Portland cement, zero to 1/10 part hydrated lime, fine aggregate equal to 2-1/4" to 3 times the sum of the Portland cement and lime and sufficient water to produce fluid consistency without segregation of components (slump 8" to 10" when measure by ASTM C143).

2.4 ANCHORS AND TIES

- A. Cold drawn steel. All joint reinforcement, anchors, and ties shall be hot-dip galvanized in accordance with ASTM A153-82, Class B2.
- B. Stone Anchoring System:
 1. For adjustable two-piece anchors, anchors of wire size W1.7, and 22 gage corrugated sheet-metal anchors, provide at least one anchor for each 2.67 sq.ft. of wall area. For other anchors, provide at least one anchor for each 3.5 sq.ft. of wall area. Space anchors at a maximum of 32 in. (813 mm) horizontally and 18 in. vertically. Provide additional anchors around openings larger than 16 in. in either dimension. Space anchors around perimeter of opening at a maximum of 3 ft on center. Place anchors within 12 in. (305 mm) of openings.
 2. Corrugated sheet-metal anchors: Corrugated sheet-metal anchors shall be at least 7/8 in. wide, have a base metal thickness of at least 0.03 in. and shall have corrugations with a wavelength of 0.3 to 0.5 in. and an amplitude of 0.06 to 0.10 in. Corrugated sheet-metal anchors shall be placed as follows: Embed anchors in the mortar joint and extend into the veneer a minimum of 1 1/2 in., with at least 5/8-in. mortar cover to the outside face.
 3. Sheet-metal anchors: Sheet-metal anchors shall be at least 7/8 in. wide, shall have a base metal thickness of at least 0.06 in and shall have corrugations as specified for Corrugated sheet metal anchors, or be bent, notched, or punched to provide equivalent performance in pull-out or push-through. Sheet-metal anchors shall be placed as follows: embed anchors in the mortar joint and extend into the veneer a minimum of 1 1/2 in., with at least 5/8-in. mortar cover to the outside face.
 4. Wire anchors: Wire anchors shall be at least wire size W1.7 and have ends bent to form an extension from the bend at least 2 in. long. Wire anchors shall be placed as follows: embed anchors in the mortar joint and extend into the veneer a minimum of 1 1/2 in., with at least 5/8-in. mortar cover to the outside face.

2.5 SEALANT AND BACKER ROD (General Contracts)

- A. General: Provide Sika Flex Primer and Sika Flex 1A joint sealant. Color shall be selected by CO. Provide Sika® Backer Rod.

2.6 CLEANING MATERIAL

- A. Water: Potable
- B. Detergent: Non-Ionic
- C. Do not use acids

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Remove debris, ice, ponding water, and other foreign matter that might prevent bonding of masonry to supporting elements
- B. Stone Preparation: Do not construct masonry during rain, sleet, or snow without protection. Follow approved hot and cold weather procedures.
- C. Clean reinforcement, anchors, and ties before setting in mortar or grout.

3.2 FABRICATION AND INSTALLATION

- A. General: Set stone in accordance with the Drawings and approved mock-up and shop drawings. Employ skilled stone masons.
 - 1. Provide chases, reveals, ringlets, openings and other spaces for contiguous work As indicated or required by field conditions. Close up other openings after contiguous work is installed using material and setting methods to match surrounding stone work.
 - 2. Where stone work contacts ferrous metal surfaces which will be concealed in back-up construction, apply a heavy coat of bituminous paint on metal surfaces prior to setting stone. Do not coat metal surfaces which will be exposed in finish work or surfaces of stainless steel or non ferrous metals.
 - 3. Erect walls plumb and true, in accordance with specified or approved pattern.
- B. Fabrication of Stone (CCC Culvert Headwalls):
 - 1. Reuse existing salvage stone in pattern, size, shapes, dimensions prior to fabricating new stone.
 - 2. Fabricate sizes, shapes, dimensions, and details and as shown on the Drawings. Tool stones as needed to meet size and shape dimensions indicated. Use suitable on-site salvaged stone and collected stone acceptable stone source. Keep exposed surfaces and edges of units free from cracks, broken corners, chipped edges, or other defects. No patching or hiding of defects will be permitted.

3. Tool and shape stone where required for fitting, pitch and wash. Make faces of units in same plane flush at joint.
4. Beds and Joints: Pieces shall be bedded and joined as shown on the Drawings.
5. Anchor Provision: Cut and drill stone to provide provisions and holes in stone/bedrock for anchors, fasteners, and reinforcing. Allow room for expansion of the anchoring devices where necessary.
6. Laying Stone:
 - a. Lay with longest faces horizontal in full beds of mortar. Use pattern of existing stone wall as per approved shop drawings. For new sections: use largest stones for bottom courses and at corners. Uniformly distribute larger "bonder" stones as indicated on the Drawings. Do not bunch small or equal size stones. Uniformly distribute weathered, colored, or varying textured stones throughout exposed faces of work as per approved shop drawings.
 - b. Maximum projection beyond batter lines as per original wall (field verify at 1-1/2 inches). Four corners of adjacent stones shall not be contiguous.
 - c. Stone shall be laid with seams or strata in a horizontal plane. Homogenous stones, with No seams or stratification, may be laid with their longest dimension in a horizontal plane. Stones with exposed edges having the appearance of having been sheared, sawn, or otherwise cut will not be permitted.
 - d. Protect stone faces from staining. When work is not in progress, keep tops of walls covered with approved non-staining waterproof coverings. When work resumes, clean loose mortar from stone. Where new masonry joins partially or totally set masonry, remove loose mortar and dampen stone before laying new course.
 - e. Build in anchors, ties, dowels, weep holes, and work of other trades. Set each stone level in a full bed of mortar and tap to an even bearing. Fill joints with mortar leaving no voids. Keep faces of stone free of mortar.

C. Fabrication of Stone (Stone Veneer Walls):

1. Fabricate sizes, shapes, dimensions, and details and as shown on the final drawings. Keep exposed surfaces and edges of units free from cracks, broken corners, chipped edges, scratching, or other defects. No patching or hiding of defects will be permitted.
2. Edges:
 - a. Guillotine: Size units to produce 1/2"-wide joints for guillotine cut unless otherwise indicated. Guillotine cut stone full and true on faces, reveals, beds, joints, and top, to the full dimensions required. Use a splitting devise that applies pressure from both top and bottom of the stone.
3. Cut stone where required for pitch and wash. Make faces of units in same plane flush at joint. Pitch stone to convex, pillowed faces.
4. Cut, drill, and fit stone to accommodate this and adjacent work. Carefully cut edges to a neat, tight fit and grind and rub smooth. Use templates for cutting and drilling as obtained from proper trades.
5. Backs of Pieces: Saw backs of pieces to approximately true planes where gauged stones are indicated on the drawings. Backs of pieces not gauged shall be roughly dressed or split faced to approximately true planes and thickness specified.
6. Beds and Joints: Pieces shall be bedded and joined as shown on the Drawings.
7. Anchor Provision: Cut and drill sink provisions and holes in stone for anchors, fasteners, and supports, as indicated or needed to set stone in place. Allow room for expansion of the anchoring devices where necessary.
8. Laying Stone:

- a. Lay with longest faces horizontal in full beds of mortar. Use largest stones for bottom courses and at corners as noted on Drawings. Uniformly distribute larger “bonder” stones as indicated on the Drawings. Decrease stones in size from bottom to top. Do not bunch small or equal size stones. Uniformly distribute weathered, colored, or varying textured stones throughout exposed faces of work.
- b. Pitch face to true lines along beds and joints. Maximum projection beyond pitch lines: 1-1/2 inches. Four corners of adjacent stones shall not be contiguous.
- c. Stone shall be laid with seams or strata in a horizontal plane. Homogenous stones, with no seams or stratification, may be laid with their longest dimension in a horizontal plane. Stones with exposed edges having the appearance of having been sheared, sawn, or otherwise cut will not be permitted.
- d. Protect stone faces from staining. When work is not in progress, keep tops of walls covered with approved non-staining waterproof coverings. When work resumes, clean loose mortar from stone. Where new masonry joins partially or totally set masonry, remove loose mortar and dampen stone before laying new course.
- e. Build in anchors, ties, dowels, weep holes, and work of other trades. Set each stone level in a full bed of mortar and tap to an even bearing. Fill joints with mortar leaving no voids. Keep faces of stone free of mortar.
- f. Veneer stone shall be laid with not less than 1 inch of grout between stone and backing wall. Cavity wall stone shall be laid with not less than 6 inch cavity to be fully grouted.

D. Fabrication of Stone (CCC Stone Curb):

- 1. Stone shall be reused from existing on-site salvaged stone curb stone. Tool stone to fit sizes, shapes, dimensions, and details as indicated on the Drawings. Keep exposed surfaces and edges of units free from cracks, broken corners, chipped edges, or other defects. No patching or hiding of defects will be permitted.
- 2. Fit stone to accommodate this and adjacent work. Tool stone to fit radiused corners.
- 3. Beds and Joints: Pieces shall be bedded as indicated.

3.3 GROUTING AND MORTAR

- A. Clean spaces to be grouted of all mortar droppings, loose aggregate, and debris. Secure all reinforcement, anchors, and ties in accurate locations.
- B. Mix grout thoroughly to a plastic mix suitable for pumping without segregation.
 - 1. Place grout before any initial set occurs, within 1-1/2 hours after water has been added.
 - 2. Grout pour height shall not exceed 5 feet. Consolidate grout at time of placement by mechanical vibration. Reconsolidate after initial water loss and settlement by mechanical vibration.
 - 3. Do not use aluminum equipment for handling or pumping grout.

3.4 TOLERANCES:

- A. Variation of Slope and Grade: Within 1" in 10 feet of level or true plane as applicable when checked with a 10-foot straight edge.

3.5 ADJUSTING AND CLEANING:

- A. Remove and replace stonework that is broken, chipped, stained or otherwise damaged; where there is a defective joint; where stones do not match approved samples; where stonework, including joints, does not match approved field-constructed mock-up; and where stonework does not comply with other parts of this specification.
- B. Cleaning:
 - 1. Before cleaning finished masonry, apply the approved cleaning agents to approximately 24 square inch sections of sample walls. After seven days, observe results. If mortar joints and masonry units are not adversely affected, use the same cleaning materials and methods on completed building and site walls.

3.6 CLEAN UP AND PROTECTION

- A. Protect adjacent surfaces during progress of the Work in this Section.
 - 1. Protect base of walls from rain-slashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
- B. Stone Cleaning:
 - 1. Clean stone work not less than seven days after completion, using clean water and stiff bristle brush. Do not use wire brushes or harsh caustic cleaners.
- C. Protection Of Work:
 - 1. Protect completed or in-place stone work from damage due to subsequent construction or finishing activities.
 - 2. Biological Cleaning:
 - a. Demonstrate materials and methods to be used for cleaning biological and atmospheric growth from stone.
 - b. Samples should reflect a minimum of 9 SF of cleaning and should include a variety of growth and stains
 - 3. Other Cleaning:
 - a. Demonstrate materials and methods (as prescribed in sections 2 and 3) to be used for cleaning "orange" stain from stone.
 - b. Samples should reflect a minimum of 2 SF of cleaning.
 - 4. Protect sills, ledges, paving, and projections from droppings of mortar and sealants.
 - 5. Protect work not to be cleaned. Clean exposed masonry from top down, scrubbing with non-metallic soft bristle brushes and water to remove stains, efflorescence, and mortar, cleaning only a small area at a time. Rinse surfaces thoroughly with clean water immediately after cleaning to avoid etching or staining masonry. If cleaning solutions are necessary, wet walls before applying solutions. Approved solutions of soap powder or mild detergents may be applied no sooner than 48 hours after construction.
 - 6. Barricade work areas during setting, grouting, pointing, and sealing. Keep barricades in place until mortar and cement has fully cured at least five (5) days. Maintain barricade protection one day additional for each day during the curing period the average daily temperature is 45° or less.

7. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials from stone without damage to latter.
8. After installation and cleaning, protect work from damage during subsequent construction activities until Work is accepted.

D. Construction Cleaning:

1. Remove all excess materials, packaging materials, debris, and tools; leave the site and work area in clean condition. Leave protected coverings in place until final cleaning.

3.7 REPLACEMENT

A. Damaged Or Defective Work:

1. Repair to the satisfaction of the Contracting Officer, or replace at no additional cost, work which has been damaged or found to be defective prior to final completion and acceptance of the Work by the Contracting Officer.
2. Remove and replace broken, chipped, stained, or damaged stones, or stones which do not match adjacent stone color or pattern. Provide new matching stones, install as specified herein, and point joints to eliminate evidence of replacement.
3. Repoint defective and unsatisfactory joints as required to provide a neat, uniform appearance.

END OF SECTION 043100

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural steel for buildings.
- B. Related Sections:
 - 1. Section 05 50 00: "Metal Fabrications."

1.2. DEFINITIONS

- A. Structural Steel Framing: That work defined in Section 2.1 of the AISC "Code of Standard Practice", as shown on drawings and specified herein.

1.3. REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual; American Institute of Steel Construction, Inc.
- B. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc..
- C. ASTM A588 – Standard Specification for Weathering Steel.
- D. ASTM A847 – Standard Specification for Cold-Formed Welded and Seamless High-Strength, Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance
- E. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society.
- F. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society.

1.4 SUBMITTALS

- A. Product Data: Description, including composition of shop primer paint.
- B. Shop Drawings:
 - 1. Submit before fabrication.
 - 2. Show size and weight of members, and types and locations of shop and field connections.
 - 3. Using AWS welding symbols, show type, size, and extent of welds and welding sequence.
 - 4. Approved shop drawings will be for size and arrangement of members and strength of connections; errors in dimensions will be responsibility of Contractor.
- C. Erection Drawings:
 - 1. Submit erection drawings defining location of each assembly or piece within structure.
 - 2. Provide sufficient details to describe all field welding.

3. Subsequent submittals of erection drawings which modify or add to earlier versions will be clearly marked.
 4. Reproduction of Contract Documents is not permitted.
- D. Mill Test Reports:
1. Furnish Mill Test Reports for all Structural Steel.
 2. Submit one copy each to Contracting Officer and General Contractor's testing agency.
- E. Certifications: Submit to Contracting Officer and Contracting Officer's testing agency.
- F. Contractor Requested Changes:
1. All contractor requests for substitutions of member sizes or material grades or modification of strength or configuration of structural steel framing for contractor's convenience, erection sequence, or construction equipment, shall be subject to Contracting Officer's written approval.
 2. Contractor shall compensate Contracting Officer of record to make these changes or review design calculations of others and modify construction documents.

1.5 QUALITY ASSURANCE

- A. Fabricator and Erector Qualifications:
1. Experienced in fabrication and erection of structural steel framing for projects of similar size and difficulty.
 2. Subject to approval of Contracting Officer.
- B. Welder Qualifications: Welding shall be done only by welding operators currently qualified according to AWS D1.1.
- C. Testing Agency:
1. Testing and inspection will be made by an approved testing laboratory selected and paid by General Contractor.
 2. Furnish testing agency access to work, facilities, and incidental labor required for testing and inspection.
 3. Retention by General Contractor of an independent testing agency shall in no way relieve General Contractor of responsibility for performing all work in accordance with contract requirements.
- D. Meetings:
1. Pre-Installation Conference: Schedule and attend meeting prior to beginning steel erection at site.
 2. Refer to Section 013100, "Project Management and Coordination" for detailed requirements.
- E. Unidentified Members:
1. Structural steel framing members shown but not identified as to size, section and/or material grade will be included in bid price for Work by assuming sizes, sections and/or material grades, shown for similarly loaded members having approximately same overall length.
 2. All such members and their associated cost will be identified in bid for Work.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Coordinate delivery of structural steel items to be built into masonry and concrete with scheduling of work of those trades.
- B. Storage of Structural Steel Framing:
 - 1. Support members which are stored at project site above ground on platforms, skids, or other supports, upright to prevent twisting.
 - 2. Protect steel from corrosion.
 - 3. Store other materials in a weather-tight and dry place, until ready for use.
 - 4. Store packaged materials in their original, unbroken package or container.
- C. Where materials are to be stored on structure, store in a manner that will not cause distortion or damage supporting structure.
- D. Repair or replace damaged materials or structures as directed.

1.7 JOB CONDITIONS

- A. Protect any adjacent materials or areas below from damage due to weld splatter or sparks during field welding.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

- A. W-Shapes shall be ASTM A992.
- B. Channels, angles, plates and bars shall be ASTM A36.
- C. Hollow Structural Sections (HSS) rectangular shapes shall be ASTM A500, Grade C.

2.2 WEATHERING STEEL (WHERE NOTED ON DRAWINGS)

- A. Shapes, Plates, and Bars shall conform to ASTM A588, 50 ksi yield.
- B. Hollow Structural Sections (HSS) rectangular shapes shall conform to ASTM A847, 50 ksi yield.

2.3 FASTENERS AND ANCHORS

- A. Carbon Steel: ASTM A307, Grade A Bolts and Nuts; ASTM A36 Threaded Rods.
- B. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washer.
 - a. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type.
- C. Anchor Rods: ASTM F 1554, Grade 36 or Grade 55, weldable, as noted on drawings.
 - a. Plate Washers: ASTM A36.
 - b. Nuts: ASTM A 563 heavy-hex.
 - c. Washers: ASTM F 436, Type 1, hardened.

2.4 FILLER METAL FOR WELDING

- A. Section A3.6 of AISC Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design, latest edition.
- B. Filler metal for steel shall have a minimum tensile strength of 70,000 PSI.
- C. Filler metal for welds on A588 steel shall produce welds that match the weathering characteristics of the base material.

2.5 GROUT

- A. Premixed, nonshrink, nonmetallic hydraulic-cement grout, ASTM C1107, Grade A. Place 1-1/2" of grout under column base plates.

2.6 PAINT

- A. Where steel is to be field painted, provide shop coat of painting compatible with finish painting system specified in Division 09.
- B. Do not paint galvanized steel, steel to be encased in concrete, weathering steel or concealed steel.
- C. Apply one coat of shop paint to other structural steel, complying with Section M3 of AISC Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design.
- D. Galvanizing Repair Painting: High zinc dust content painting for touch-up of welds and weld areas.

2.7 FABRICATION

- A. Structural Steel:
 - 1. AISC 360 Specification for Structural Steel Buildings.
 - 2. Fabricate and assemble structural steel framing assemblies in shop to greatest extent practicable, in accordance with reference standards cited herein and final shop drawings.
 - 3. Use detailing and fabrication procedures that account for distortion and shrinkage due to welding processes, both in shop and in field.
 - 4. Fabricate and assemble structural steel framing assemblies in shop to greatest extent practicable, in accordance with reference standards cited herein and final shop drawings.
- B. Finishes:
 - 1. Where painting is indicated, use painting methods which result in full coverage of joints, corners, edges and exposed surfaces.
 - 3. Apply one coat of shop paint to other structural steel, complying with Section M3 of AISC Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design.
- C. Cutting and Fitting:
 - 1. Perform all necessary cutting, fitting and drilling for accommodation of other trades.

2. Secure correct information for required openings both before and after steel is delivered.
3. No cutting or drilling will be permitted on job without acceptance of Contracting Officer.

D. Welding:

1. Comply with AISC specifications and latest American Welding Society standards.
2. Welds not specified shall be 3/16 inch fillet continuous but not less than AISC minimum based on thickness of parts joined.

E. Substitutions: Where exact sizes and weights called for are not readily available, secure Contracting Officer's Representative acceptance of suitable sizes in time to prevent delay due to such substitutions.

3.0 ANCHORS

- A. Provide all anchors for columns, beams, plates, etc., as shown or as required.
- B. Anchor Bolts: Size and length as shown.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Prior to start of erection, structural steel framing erector shall check elevation of all bearing surfaces and location of all embedded anchor bolts and connection plates and report all deviations from Contract Documents to Contracting Officer.
- B. Do not proceed with erection until all unacceptable conditions are corrected.

3.2 PREPARATION

- A. Take measurements on site as required for correct fabrication and installation.
- B. Fabricator shall be responsible for errors in fabrication and for correct fit of structural steel framing.

3.3 INSTALLATION

- A. Erection:
 1. Erect structural steel framing in accordance with AISC Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design, latest edition.
 2. When erecting members shown as exposed structural steel, use procedures of Section 10, AISC Code of Standard Practice for Steel Buildings and Bridges, latest edition.
 3. Column Bases and Bearing Plates:
 - a. Align with wedges or shims.
 - b. When framework is plumb, grout solid under entire bearing surfaces of plates following instructions of grout manufacturer.
 - c. Set base and bearing plates and leveling plates level and at correct elevations on roughened surfaces cleaned of all bond-reducing materials.

- d. Provide setting drawings, templates permanently marked with column center lines and north arrow, and directions for installation of anchor bolts and other devices.
 4. Field Assembly:
 - a. Assemble structural steel framing to lines and elevations indicated within specified erection tolerances.
 - b. Align various members forming a complete frame or structure after assembly and adjust accurately before being fastened.
 - c. Do not splice members except where indicated on drawings.
 - d. Do not alter structural steel framing members without approval of Contracting Officer.
 5. Field Connections:
 - a. Make field connections with bolts, high-strength bolts or field welding.
 - b. Clean existing surfaces before welding to existing steel.
 - c. No drifting or cutting to enlarge unfair holes will be allowed.
 - d. Make minor corrections by reaming.
 - e. Serious defects may not be corrected in field but shall be called to attention of Contracting Officer for a decision as to method and/or procedure for repair by Contractor.
 6. Temporary Bracing:
 - a. Consider all structural steel framing as non-self-supporting steel frames.
 - b. Provide suitable temporary bracing as necessary to maintain structural steel framing in proper position until permanently secured.
 - c. Structural steel framing is permanently secured when it has its complete gravity and lateral load resisting systems in place including floor and roof diaphragms, vertical bracing and foundations.
 - d. Contractor shall coordinate installation of all non-structural steel items which will load non-self supporting structural steel frame.
 - e. Structural steel framing temporary supports shall resist all loads from these non-structural steel items.
 7. Field Modification:
 - a. Obtain written acceptance from Contracting Officer before use of flame cutting for field modification or re-fabrication of structural steel framing.
 - b. Structural steel framing fabricator shall be responsible for errors in fabrication and for correct fit in field.
 8. Drilled-In Inserts:
 - a. Install in accordance with manufacturer's recommendations in accurately drilled holes of required diameter and depth.
 - b. Do not drill holes in concrete or masonry until material has achieved full design strength.
- B. Erection Tolerances: Comply with requirements of AISC Code of Standard Practice, except as follows:
1. Columns:
 - a. Maximum deviation from established column line shall not exceed 3/8 inch, accumulative from all sources.
 - b. Column bases shall be located on established center lines (plan dimension) within plus-or-minus 1/8 inch; bases shall be at specified elevation plus-or-minus 1/16 inch.
 2. Members Connecting to Columns:
 - a. Horizontal deviation of member working point from position with respect to supporting column working line shall not exceed plus-or-minus 1/16 inch from location shown.
 - b. Elevation deviation of member working point with respect to upper splice line of supporting column shall not exceed plus 1/8 inch or minus 1/4 inch from elevation shown.

3. Other Members: Deviation of member working point horizontal location and elevation with respect to supporting member shall not exceed plus-or-minus 1/16 inch from location and elevation shown.
4. Leveling and Plumbing: Base leveling and plumbing on a mean temperature of 70 degrees F.
5. Compensate for difference in temperature at time of erection.

3.4 FIELD QUALITY CONTROL

A. Independent Testing Agency Services:

1. Field Inspection:
 - a. Inspection of field welding as required by Statement of Special Inspections.
 - b. Ascertainment of proper fit and alignment.
 - c. Ascertainment of proper installation and tensioning of bolts.
2. Welding Inspection:
 - a. Ascertain that electrodes used for manual shielded metal-arc welding and electrodes and flux used for submerged arc welding conform to requirements herein.
 - b. Ascertain that welding is performed only by welding operators and welders who are properly certified.
 - c. Shall witness such qualification testing of welding operators and welders, as may be required.
 - d. Ascertain that fit-up, joint preparation, size, contour, extent of reinforcement, and length and location of welds conform to specified requirements and contract drawings, and that no specified welds are omitted or unspecified welds added without approval of Contracting Officer.
 - e. If defective welds are discovered, remaining un-inspected welds will receive such ultrasonic or magnetic particle inspection as may be required by Contracting Officer.
 - f. All cost of additional inspection required by this paragraph shall be borne by Contractor.
 - g. Welding inspector will have authority to reject welds.
 - h. Such rejection may be based on visual inspection where in his opinion welds would not pass a more detailed investigation.
 - i. Reports by Testing Agency's inspector will contain, as a minimum, an adequate description of each weld tested, identifying mark of welder responsible for weld, critique of any defects noted by visual inspection or testing, and a statement regarding acceptability of weld tested, as judged by current A.W.S. standards.
 - j. Reports will be distributed as early as possible, but no later than one work week after tests have been performed.
 - k. Contracting Officer will be notified by phone if, in judgement of inspector, test results require immediate comment.
3. Bolted Connections:
 - a. Visually inspect all bolted connections to ascertain that all bolts, nuts and required washers have been installed and are of proper type and that all faying surfaces have been brought into snug contact.
 - b. Verify specified surface preparation of faying surface has been correctly prepared.
4. Drilled-In Inserts:
 - a. Self-Expanding Inserts:
 - 1) Prior to installation, determine that installing contractor has proper materials and equipment for drilling holes in receiving surface of required diameter and length.
 - 2) Visually inspect all inserts after installation to ensure that they have been installed perpendicular to receiving surface and to proper depth.
 - 3) Inspect 10 percent of all inserts at each level for a tension load of 150 percent of manufacturer's recommended allowable working loads in tension.

- 4) Inspect 100 percent of inserts for a “snug tight” condition.
 - 5) Snug tight is defined as a measured torque of at least 100 percent of manufacturer’s recommended installation torque.
- b. Adhesive-Bonded Inserts:
- 1) Inspect adhesive-bonded, drilled-in inserts.
 - 2) Be present at site to observe installation of all inserts placed.
 - 3) Such observation shall be to ensure that drilled holes are of required diameter and depth, holes are properly cleaned prior to installation of insert, and that holes are completely filled with properly mixed adhesive after installation.
 - 4) Visually inspect all inserts after installation to ensure that insert has been installed perpendicular to receiving surface and to proper depth.
 - 3) Inspect all inserts for a tension load of 100 percent of manufacturer's recommended allowable working loads in tension.

END OF SECTION 05 12 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal ladders.
 - 2. Metal screen.
 - 3. Metal supports/attachments for built in shelves.
 - 4. Metal gates.
 - 5. Bid Option 6: Weathering Steel Metal Screen.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete.
- C. Related Requirements:
 - 1. Section 05 12 00 "Structural Steel Framing" for steel framing, supports, door frames, and other steel items attached to the structural-steel framing.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
 - 2. Fasteners.
 - 3. Shop primers.
 - 4. Shrinkage-resisting grout.
 - 5. Manufactured metal ladders.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Steel framing and supports for mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 3. Metal ladders.
 - 4. Metal screen (refer to drawings for basis of design)
 - 5. Metal gates.

6. Shelf supports.

- C. Delegated Design Submittal: For ladders, metal screens, and metal gates including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. If submitting an off-the-shelf ladder, delegated design may be substituted with product data but must include design loads, complete description of sizes and configuration, and finishes.

1.4 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design ladders, metal screens, and metal gates.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Regional Materials: Manufacture products within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If transporting materials by rail or water, multiply the distance transported by rail or water by 0.25 to determine the distance to Project site.
- C. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- D. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 316L.
- E. Weathering Steel Bars and Shapes (Bid Option 6): ASTM A606,
- F. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 316L.
- G. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallurgically bonded to steel.
 - 1. Source Limitations: Obtain floor plate from single source from single manufacturer.
- H. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- I. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening stainless steel .
 - B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
 - C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
 - D. Weathering Steel Bolts (Bid Option 6): ASTM A325 or ASTM A449
 - E. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 2.
 - F. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
 - G. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
 - H. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
 - I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.
- 2.4 MISCELLANEOUS MATERIALS
- A. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting."
 - B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
 - C. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.

2. Furnish inserts for units installed after concrete is placed.

C. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 METAL ELEMENTS

A. General:

1. Comply with ANSI A14.3.

B. Metal Screen:

1. Fabricate metal screen bars, HSS tubes, and plates as shown on drawings, including sizing, spacing, and other layout elements.
2. Ends of HSS tubes shall be capped with a welded steel plate and 3/8" hole drilled through bottom seam of each end to allow moisture to escape.
3. Drill through each end of HSS tube for two 3/4 inch anchor bolts to be attached to column and to building.
4. Screen shall be constructed in the shop and shop primed with primer as specified in Section 09 91 13 "Exterior Painting."
5. Attachment to building and column shall be with 3/4 inch stainless steel anchor bolts.
6. For Bid Option 6, provide metal screen as described above but constructed entirely with weathering steel.

C. Steel Ladders:

1. Space siderails 16 inches apart unless otherwise indicated.
2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 1-inch-diameter or 1-inch-square, steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
7. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch in least dimension.
8. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
9. Prime ladders, including brackets and fasteners, with zinc-rich primer.

D. Metal Gates:

1. Fabricate metal gates, posts, anchor posts, lock boxes, plates, and related items as shown on drawings, including sizing, spacing, and other layout elements.

2.8 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.9 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL AND IRON FINISHES

- A. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer or primers specified in Section 09 91 13 "Exterior Painting" unless zinc-rich primer is indicated.
- B. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
 - 4. Do not prepare for any priming for Bid Option 6.
- C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Do not apply any priming for Bid Option 6. Metal shall remain bare to weather naturally.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for

use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor shelf angles securely to existing construction with expansion anchors or anchor bolts .
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.
 - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLATION OF THRESHOLDS

- A. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 07 92 00 "Joint Sealants" to provide a watertight installation.

3.4 INSTALLATION OF BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 REPAIRS

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting." and Section 09 91 23 "Interior Painting."
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 50 00

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood framing.
 - 3. Sheathing.
- B. Related Sections:
 - 1. Section 06 17 00: “Shop-Fabricated Structural Wood.”
 - 2. Section 09 21 16: “Gypsum Board.”

1.2 DEFINITIONS

- A. Rough Carpentry: Includes carpentry work not specified as part of other Sections and generally not exposed.

1.3 SUBMITTALS

- A. Product Data: Unless otherwise indicated, submit the following for each type of product provided under work of this Section:
 - 1. Recycled Content:
 - a. Engineered Wood Products:
 - 1) Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
 - 2) Indicate relative dollar value of recycled content product to total dollar value of product included in project.
 - 3) If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
 - 4) If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.
 - 2. Local/Regional Materials:
 - a. Sourcing Location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and project site.
 - b. Manufacturing Location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and project site.
 - c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
 - d. Product Component(s) Value:
 - 1) Where product components are sourced or manufactured in separate locations, provide location information for each component.
 - 2) Indicate the percentage by weight of each component per unit of product.
 - 3. VOC Data:
 - a. Adhesives:
 - 1) Submit manufacturer’s product data for adhesives. Indicate VOC limits of product. Submit MSDS highlighting VOC limits.

- b. Engineered Wood Products: Provide documentation that composite wood and agrifiber products contain no added urea-formaldehyde resins.
 - 1) ANSI A208.1 – 1999, Particleboard.
 - 2) ANSI A208.2 – 2002, Medium Density Fiberboard (MDF) for Interior Applications.
- B. Product Data:
 - 1. Wood Treatment data including chemical treatment manufacturer’s instructions for handling, storing, installation, and finishing of treated material.
 - 2. Preservative treated wood product shall include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
 - 3. Timber connectors data including load capacities, corrosion protection, and evidence that products meet the requirements of this Section.
- C. Shop Drawings: Show dimensions, layout of roof framing, framing connection details, and fastener connections.

1.4 QUALITY ASSURANCE

- A. Sustainably Harvested Wood: Certification Organizations shall be accredited by the Forest Stewardship Council, or Sustainable Forestry Board.
- B. Recycled Content Materials: Where recycled lumber materials are used for structural applications, include lumber certification and quality grading.
- C. Engineered Wood Products:
 - 1. Determine formaldehyde concentrations in air from wood products under test conditions of temperature and relative humidity in accordance with ASTM D6007 or E1333.
 - 2. Determine Volatile Organic Compounds (VOC), excluding formaldehyde, emitted from manufactured wood-based panels in accordance with ASTM D6330.
- D. Comply with International Building Code and National Design Specification for Wood Construction, latest edition, as published by the National Forest Products Association.
- E. Composite wood and agrifiber products shall contain no added urea-formaldehyde resins.
- F. Identify lumber and structural wood panels by official grade mark.
- G. Lumber: Grade stamp containing, where applicable, symbol of grading agency, rules under which graded, mill number or name, grade of lumber, species or species grouping, and condition of seasoning.
- H. Plywood Panels and Underlayments: APA grade trademark, including type, grade, class, identification or span rating, and inspection and testing agency mark.
- I. Engineered Wood Products: Each member shall be stamped to indicate product type, grade, CABO Report Number, and identification of independent inspection agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials a minimum of 6 inches above ground in area protected from weather.

- B. Protect with waterproof covering allowing adequate air circulation.
- C. Do not store seasoned materials in wet or damp environments.
- D. Store engineered wood products in accordance with manufacturer's instructions.
- E. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary waterproof coverings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Lumber:
 - 1. Resource Management:
 - a. Virgin Lumber:
 - 1) Lumber fabricated from old growth timber is not permitted.
 - 2) Provide sustainably harvested; certified or labeled in accordance with FSC, SFI guidelines.
- B. Engineered Wood Products:
 - 1. Toxicity/IEQ:
 - a. Products shall contain no added urea-formaldehyde.
 - 1. Comply with PS 20 (latest edition) "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
 - 2. Inspection agencies and abbreviations used to reference them with lumber grades and species include following:
 - a. WCLIB – West Coast Lumber Inspection Bureau.
 - b. WWPA – Western Wood Products Association.
 - 3. Moisture Content: 19 Percent maximum (dry) at time of manufacture for lumber 2 inches or less in thickness.
 - 4. Surfacing: S4S, unless otherwise specified.
 - 5. Dimensions: All dimensions are nominal.
 - 6. Species: Any commercial softwood species may be used, unless a particular species is specified or shown.
- B. Structural Lumber:
 - 1. Any species and grade that complies with following requirements for species groups defined in Table 8.1 of N.F.P.A. National Design Specification, for extreme fiber stress in bending "F_b" for single and repetitive members, and for modulus of elasticity "E."
 - 2. Joists and Rafters: DF-L No. 2 or Better.
 - 3. Beams, Posts, and Timbers: DF-L No. 1 or Better.
 - 4. Studs: DF-L Stud Grade
- C. Non-Structural Lumber:
 - 1. Blocking and Miscellaneous Lumber: Utility grade.
 - 2. Exposed framing lumber, provide material complying with following requirements:
 - a. Exposed framing refers to dimension lumber that is not concealed by other construction

- and is indicated to receive a stained or natural finish.
- b. DF-L, "Select Structural" grade per WWPA rules.

D. Plywood Panels:

1. Comply with PS 1 "U.S. Product Standard for Construction and Industrial Plywood" for plywood construction panels and, for products not manufactured under PS 1 provisions, with APA PRP-108.
2. Backing Panels for Mounting Electrical Equipment: APA C-D Plugged Exposure 1, 15/32-inch thick, minimum.
3. Panels for Mounting Telecommunications Equipment: APA C-D Plugged Exposure 1, 1/2-inch thick, minimum.
4. Panels for Mounting Toilet Accessories: APA C-D Plugged Exposure, 15/32-inch thick, minimum.

E. Roof Sheathing:

1. 40/20 APA rated sheathing.
2. Thickness: 19/32 inch.
3. Exposure Durability Classification: EXTERIOR.

F. Wall Sheathing:

1. 24/16 APA rated sheathing.
2. Thickness: 7/16 inch.
3. Exposure Durability Classification: EXTERIOR.

G. Engineered Wood Products Toxicity/IEQ: Products shall contain no added urea-formaldehyde.

2.2 ACCESSORIES

A. Adhesive:

1. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials, GS-36 for Commercial Adhesive South Coast Air Quality Management District Rule 1168, and as specified.

B. Fasteners:

1. Recycled Content: Fabricated from 100 percent re-melted steel.
2. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
3. Use hot-dip galvanized coating per ASTM A153 or aluminum hardware for exterior use and AISI Type 304 stainless steel for fire-retardant treated wood.
4. Types:
 - a. Nails: ASTM F1667.
 - b. Power Driven Fasteners: National Evaluation Report NER0272.
 - c. Wood Screws: ANSI B18.6.1.
 - d. Lag Bolts: ANSI B18.2.1.
 - e. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.

B. Wood Connectors: Strong-Tie by Simpson Company, San Leandro, CA or an equivalent product of an approved manufacturer with equal or greater load capacity for all directions of loading.

C. Plywood Panel Clips: ASTM B221, 6063-T6, extruded aluminum alloy.

- D. Corrosion Resistant Fasteners and Connecting Hardware:
1. Provide hot-dipped galvanized connecting hardware, nails, and fasteners when attaching to or penetrating preservative treated wood products.
 2. ASTM A276, Type 304 or 316, stainless steel nails and fasteners may also be used.
- E. Nail Identification:

Length	Diameter	Name	Emboss ID EZ Code	Color Code Tracker
2-3/8 inches	0.113 inch	8d Sinker	B	Yellow
1-1/2 inches	0.131 inch	8 Hardware	H	Black & "H" emboss
2-1/2 inches	0.131 inch	8d Common	I	Blue
3 inches	0.131 inch	10d Framer	J	White
3-1/4 inches	0.131 inch	16d Short	K	Black
1-1/2 inches	0.148 inch	10 Hardware	Q	Purple & "H" emboss
2-1/4 inches	0.148 inch	10d Shear	S	Purple
2-1/2 inches	0.148 inch	10d – 2-1/2 in.	U	Purple
3 inches	0.148 inch	10d Common	V	Purple
3-1/4 inches	0.148 inch	16d Sinker	W	Green
2-1/2 inches	0.162 inch	16d Hardware	X	Orange & "H" emboss
3-1/2 inches	0.162 inch	16d Common	Z	Orange

PART 3 – EXECUTION

3.1 SITE ENVIRONMENTAL PROCEDURES

- A. Indoor Air Quality:
1. Temporary Ventilation: Provide temporary ventilation during work of this Section.
 - a. During and immediately after installation of treated wood, engineered wood products, and laminated wood products at interior spaces, provide temporary ventilation.
- B. Waste Management: As specified in Section 01 74 19, "Construction Waste Management" and as follows:
1. Select lumber sizes to minimize waste; reuse scrap lumber to greatest extent possible.
 2. Clearly separate scrap lumber for use on site as accessory components, including shims, bracing, and blocking.
 3. Do not leave any wood, shavings, sawdust, etc. on ground or buried in fill.
 4. Prevent saw dust and wood shavings from entering storm drainage system.
 5. Do not burn scrap lumber that has been pressure treated.
 - a. Do not send lumber treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.

3.1 EXAMINATION

- A. Verify that surfaces to receive rough carpentry materials are prepared to exact grade and dimensions.

3.2 INSTALLATION

A. General:

1. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.
2. Set rough carpentry to required levels and lines, with members plumb and true to line and cut and fitted.
3. Fit rough carpentry to other construction; scribe and cope as required for accurate fit.
4. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
5. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, or as per International Building Code.
6. Countersink nail heads on exposed carpentry work and fill holes.
7. Use common wire nails, unless otherwise indicated.
8. Use finishing nails for finish work.
9. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials.
10. Make tight connections between members.
11. Install fasteners without splitting of wood; pre-drill as required.

B. Framing:

1. Comply with N.F.P.A. "Manual for Wood Frame Construction."
2. Sills:
 - a. Place sill sealer directly on foundation.
 - b. Puncture sealer so that it fits tightly around foundation anchor bolts.
 - c. Set sills level, 1/16 inch in 6 feet.
3. Construct framing members full length without splice.
4. Triple studs at corners and partition intersections.
5. Engineered Wood Products: Install in accordance with manufacturer's written instructions.
6. Install blocking at mid-height of exterior and interior walls.
7. Locate additional blocking to support finishing materials, fixtures, specialty items, and trim.

C. Roof Sheathing:

1. Follow recommendations of APA.
2. Install sheathing with long dimension perpendicular to supports, and with end joints staggered and located over supports.
3. Allow 1/8 inch space between panel ends and edges.
4. Support edge joints with sheathing clips centered between each support.

D. Furring:

1. Install plumb and level with closure strips at edges and openings.
2. Shim with wood as required for tolerance of finished work.
3. Concealed interior furring to be fire retardant treated.
4. Furring to Receive Gypsum Drywall: Install 1 inch by 2 inch furring at 16 inches OC, vertically.
5. Suspended Furring:
 - a. Install suspended furring members of size and spacing indicated, including hangers and attachment devices.
 - b. Level to a tolerance of 1/8 inch in 10 feet, except 1/4 inch in 10 feet for thick-coat plaster work.

E. Grounds, Nailers, Blocking, and Sleepers:

1. Install wood grounds, nailers, blocking, and sleepers where shown and where required for attachment of other work.
2. Form to shapes as shown and cut as required for true line and level of work to be attached.
3. Coordinate location with other work involved.
4. Concealed interior blocking to be fire retardant treated.
5. Attach to substrates as required to support applied loading.
6. Countersink bolts and nuts flush with surfaces.
7. Build into masonry during installation of masonry work.
8. Anchor to formwork before concrete placement.

END OF SECTION 06 10 00

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SECTION 06 10 63 - EXTERIOR ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Wood at Monument Sign, Variable Message Sign and Camera Wood Post
- B. Related Sections:
 - 1. Section 09 93 00 – Staining and Transparent Finishing
 - 2. Section 31 12 00 - Earth Moving

1.2 DEFINITIONS

- A. Timber: Lumber of 5 inches nominal (114 mm actual) or greater in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. RIS: Redwood Inspection Service.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

- A. Product Data: For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates:
 - 1. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.
- B. Certificates of Inspection: Issued by lumber grading agency for exposed wood products not marked with grade stamp.
- C. Evaluation Reports: For preservative-treated wood products, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Lumber Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Lumber Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.
- C. Shop Drawings for Monument Sign and Variable Message Sign.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

- A. Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by ALSC's Board of Review.
 - 1. Factory mark each item with grade stamp of grading agency.
 - 2. For items that are exposed to view in the completed Work, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
 - 4. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Regional Materials: Wood products shall be milled within 500 miles (800 km) of Project site from wood that has been harvested within 500 miles (800 km) of Project site.
- C. Certified Wood: Boards and dimension lumber shall be certified as "FSC Pure" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- D. Maximum Moisture Content:
 - 1. Dimension Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less.
 - 2. Timber. No limit.

2.2 LUMBER

- A. Hand select wood for specific items such as wood mantel, benches and framing and exterior siding at castle ruin for characteristics on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot holes, shake, splits, torn grain, and wane.
- B. Dimension Lumber: Any of the following species:
 - 1. Hem-fir or hem-fir (North); NLGA, WCLIB, or WWPA.
 - 2. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
 - 3. Mixed southern pine; SPIB.
 - 4. Redwood; RIS.
- C. Boards: Any of the following species and grades:
 - 1. Douglas fir, C & Btr finish or C Select; NLGA, WCLIB, or WWPA.
 - 2. Hem-fir, C & Btr finish or C Select; NLGA, WCLIB, or WWPA.
 - 3. Redwood, Heart Clear; RIS.
 - 4. Southern pine, B & B finish; SPIB.
 - 5. Western red cedar, Clear Heart; NLGA, WCLIB, or WWPA.

2.3 POSTS

- A. Dimension Lumber Posts: No. 2 grade and any of the following species:
 - 1. Hem-fir or hem-fir (North); NLGA, WCLIB, or WWPA.
 - 2. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
 - 3. Mixed southern pine; SPIB.
 - 4. Spruce-pine-fir or spruce-pine-fir (South); NeLMA, NLGA, WCLIB, or WWPA.
 - 5. Northern species; NLGA.
 - 6. Eastern softwoods; NeLMA.
 - 7. Western woods; WCLIB or WWPA.
- B. Timber Posts: Balsam fir, Douglas fir-larch, Douglas fir-larch (North), eastern hemlock tamarack (North), hem-fir, southern pine, western hemlock, or western hemlock (North); No. 1; NeLMA, NLGA, SPIB, WCLIB, or WWPA.

2.4 PRESERVATIVE TREATMENT

- A. Pressure treat boards and dimension lumber with waterborne preservative according to AWWA U1; Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
- B. Pressure treat timber with waterborne preservative according to AWWA U1; Use Category UC4a.
 - 1. Treatment with CCA shall include post-treatment fixation process.

- C. Pressure treat poles with waterborne preservative according to AWPA U1; Use Category UC4a.
 - 1. Treatment with CCA shall include post-treatment fixation process.
- D. Preservative Chemicals: Acceptable to authorities having jurisdiction.
 - 1. Do not use chemicals containing arsenic or chromium.
- E. Use process for boards and dimension lumber that does not include water repellents or other substances that might interfere with application of indicated finishes.
- F. After treatment, redry boards and dimension lumber to 19 percent maximum moisture content.
- G. Mark treated wood with treatment quality mark of an inspection agency approved by ALSC's Board of Review.
 - 1. For items indicated to receive a stained or natural finish, mark each piece on surface that will not be exposed.

2.5 INSTALLATION, GENERAL

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.
- B. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of members or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- C. Apply copper naphthenate field treatment to comply with AWPA M4, to cut surfaces of preservative-treated lumber.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.
 - 1. Use stainless steel fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or ASTM F 2329 unless otherwise indicated.
 - 2. For pressure-preservative-treated wood, use stainless-steel fasteners.
 - 3. For redwood, use stainless-steel fasteners.
- B. Nails: ASTM F 1667.
- C. Power-Driven Fasteners: ICC-ES AC70.

- D. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.
- E. Carbon-Steel Bolts: ASTM A 307 (ASTM F 568M) with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers all hot-dip zinc coated.
- F. Stainless-Steel Bolts: ASTM F 593, Alloy Group 1 or 2 (ASTM F 738M, Grade A1 or Grade A4); with ASTM F 594, Alloy Group 1 or 2 (ASTM F 836M, Grade A1 or Grade A4) hex nuts and, where indicated, flat washers.
- G. Post-installed Anchors: Stainless-steel, torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E 488, conducted by a qualified independent testing and inspecting agency.
 - 1. Stainless-steel bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or Grade A4).

2.7 METAL ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Products: Subject to compliance with requirements, provide comparable products by one of the following:
 - 1. Cleveland Steel Specialty Co.
 - 2. KC Metals Products, Inc.
 - 3. Phoenix Metal Products, Inc.
 - 4. R. H. Tamlyn & Sons LP.
 - 5. Simpson Strong-Tie Company, Inc.
 - 6. USP Structural Connectors.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.
- B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.
- C. Install metal framing anchors to comply with manufacturer's written instructions.

- D. Do not splice structural members between supports unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of members or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- G. Apply copper naphthenate field treatment to comply with AWP4 M4, to cut surfaces of preservative-treated lumber.
- H. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. ICC-ES AC70 for power-driven fasteners.
 - 2. "Fastening Schedule" in ICC's International Building Code.
 - 3. "Fastener Schedule for Structural Members" and "Alternate Attachments" in ICC's International Residential Code for One- and Two-Family Dwellings.
- I. Use common wire nails unless otherwise indicated. Select fasteners of size that do not fully penetrate members where opposite side is exposed to view. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads unless otherwise indicated.

END OF SECTION 06 10 63

SECTION 06 17 00 - SHOP-FABRICATED STRUCTURAL WOOD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Laminated veneer lumber.
 - 2. Laminated strand lumber.
 - 3. Rim board.
- B. Products Furnished but not Installed Under this Section:
 - 1. All prefabricated structural wood shall furnished under this Section and installed under Section 06 10 00, "Rough Carpentry."
- C. Related Sections:
 - 1. Section 06 10 00: "Rough Carpentry."

1.2 REFERENCES

- A. American Institute of Timber Construction (AITC).
- B. American Plywood Association (APA).
- C. National Forest Products Association (NFPA).
- D. Western Wood Products Association (WWPA).

1.3 SUBMITTALS

- A. Product Data: Lumber specifications including species and stress grades of lumber used.
- B. Shop Drawings: Show complete information necessary for fabrication and erection of shop fabricated structural wood members including, but not necessarily limited to following:
 - a. Indicate framing system, sizes, and spacing of members, loads, and cambers, and framed openings.
 - b. Metal connectors including gage thickness, nominal size and locations.
 - c. Design loadings of members, allowable stress increase, camber and permanent bracing required to prevent compression buckling of individual members.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Affix American Institute of Timber Construction (AITC) Quality Control Mark on each glue-laminated member furnished under this Section, or furnish AITC Certificate of Conformance to Contracting Officer attesting conformance with U. S. Product Standard PS-56-73 and these Specifications.
 - 2. Composite wood and agrifiber products shall contain no added urea-formaldehyde resins.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. If stored temporarily, place members on blocks well off ground and separated with wood strips to allow air to circulate around each member.

- B. Use non-marring slings for loading, unloading, and handling members to prevent damage to surfaces and wrapping.
- C. Handle fabricated members with care so that they are not damaged.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Laminated Veneer Lumber or Laminated Strand Lumber
 - 1. Truss Joist.
 - 2. Boise Cascade.
 - 3. Code approved equal manufacturer with products meeting the requirements of the structural drawings.

2.2 MATERIALS

- A. LVL and LSL:
 - 1. Provide type and size as shown on drawings and specified herein.
 - 2. Adhesives: Waterproof.

2.2 FABRICATION

- A. Fabricate all structural components in a properly equipped, permanent, manufacturing facility.
- B. Manufacturer structural components using experienced workmen, with precision cutting and truss assembly methods under direct supervision of a qualified foreman.

PART 3 - EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

- A. Roof Members:
 - 1. Erect and install in strict accordance with recommendations and instructions of manufacturer.
 - 2. Temporary construction loads which cause member stresses beyond design limits are prohibited.

3.2 ADJUSTING

- A. Cost of correction of all damage to work of other trades caused by erection of shop fabricated structural wood products is responsibility of this trade contractor.

3.3 CLEANING

- A. Remove all surplus materials and rubbish in connection with shop fabricated structural woodwork.

END OF SECTION 06 17 00

SECTION 06 17 53 - SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood roof trusses.

1.2 DEFINITIONS

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.
- B. Shop Drawings: Show fabrication and installation details for trusses.
 - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
 - 2. Indicate sizes, stress grades, and species of lumber.
 - 3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
 - 6. Show splice details and bearing details.
- C. Delegated Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For metal connector-plate manufacturer and fabricator.
- B. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.
- C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.
- D. Evaluation Reports: For the following, from ICC-ES:
 - 1. Metal-plate connectors.
 - 2. Metal truss accessories.

1.5 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
 - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to the Contracting Officer and is certified for chain of custody by an FSC-accredited certification body.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
 - 1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
 - 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
 - 3. Provide for air circulation around stacks and under coverings.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design metal-plate-connected wood trusses.
- B. Structural Performance: Metal-plate-connected wood trusses are to be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
 - 1. Design Loads: As indicated.
 - 2. Maximum Deflection under Design Loads: As indicated.
- C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."
- E. Regional Materials: Manufacture wood products within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If transporting materials by rail or water, multiply the distance transported by rail or water by 0.25 to determine the distance to Project site.

- F. Certified Wood: Verify wood products are made from certified wood tracked through a chain-of-custody process. Provide certified wood documentation from sources certified through a forest certification system with principles, criteria, and standards developed using ISO/IEC Guide 59 or the World Trade Organization's "WTO Agreement on Technical Barriers to Trade."

2.2 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (ALSC) Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Provide dressed lumber, S4S.
 - 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- B. Minimum Chord Size for Roof Trusses: As indicated.
- C. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 06 10 00 "Rough Carpentry."

2.3 METAL CONNECTOR PLATES

- A. Fabricate connector plates to comply with TPI 1.
- B. Hot-Dip Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.
 - 1. Use for interior and enclosed locations unless otherwise indicated.

2.4 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
- B. Nails, Brads, and Staples: ASTM F1667.

2.5 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Allowable design loads, as published by manufacturer, are to comply with or exceed those of basis-of-design products. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.

- C. Truss Tie-Downs: As indicated.
- D. Roof Truss Clips: Angle clips for bracing bottom chord of roof trusses at non-load-bearing walls, 1-1/4 inches wide by 0.050 inch thick. Clip is fastened to truss through slotted holes to allow for truss deflection.
- E. Roof Truss Bracing/Spacers: U-shaped channels, 1-1/2 inches wide by 1 inch deep by 0.040 inch thick, made to fit between two adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.
- F. Drag Strut Connectors: As indicated.

2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

2.7 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

2.8 SOURCE QUALITY CONTROL

- A. Special Inspections: Contractor will engage a qualified special inspector to perform special inspections.
 - 1. Provide special inspector with access to fabricator's documentation of detailed fabrication and quality-control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards.
 - 2. Provide special inspector with access to places where wood trusses are being fabricated to perform inspections.
- B. Correct deficiencies in Work that special inspections indicate do not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.

- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space trusses as indicated; adjust and align trusses in location before permanently fastening.
- G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- H. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
 - 1. Install bracing to comply with Section 06 10 00 "Rough Carpentry."
- I. Install wood trusses within installation tolerances in TPI 1.
- J. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- K. Replace wood trusses that are damaged or do not comply with requirements.
 - 1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by the Contracting Officer.

3.2 REPAIRS AND PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- C. Repair damaged galvanized coatings on exposed surfaces in accordance with ASTM A780/A780M and manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Special Inspections: Contractor will engage a qualified special inspector to perform special inspections to verify that temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.

END OF SECTION 06 17 53

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SECTION 06 20 23 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior trim, including non-fire-rated interior door frames.

1.2 DEFINITIONS

- A. MDF: Medium-density fiberboard.
- B. MDO: Plywood with a medium-density overlay on the face.
- C. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
- B. Samples: For each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber, mark grade stamp on end or back of each piece.
- B. Softwood Plywood: DOC PS 1.
- C. Hardboard: ANSI A135.4.

2.2 INTERIOR TRIM

- A. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):
 - 1. Species and Grade: Alder ; NHLA Clear .
 - 2. Maximum Moisture Content: 13 percent.
 - 3. Finger Jointing: Not allowed.
 - 4. Gluing for Width: Not allowed .
 - 5. Veneered Material: Not allowed .
 - 6. Face Surface: Surfaced (smooth) .
 - 7. Matching: Selected for compatible grain and color.

2.3 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
- C. Paneling Adhesive: Comply with paneling manufacturer's written instructions for adhesives.
- D. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

3.2 INSTALLATION, GENERAL

- A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.
 - 1. Use concealed shims where necessary for alignment.
 - 2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
 - 4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
 - 5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.3 INSTALLATION OF STANDING AND RUNNING TRIM

- A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.
 - 1. Do not use pieces less than 24 inches long, except where necessary.
 - 2. Stagger joints in adjacent and related standing and running trim.
 - 3. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
 - 4. Use scarf joints for end-to-end joints.
 - 5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
 - 6. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.

7. Install trim after gypsum-board joint finishing operations are completed.
8. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
9. Fasten to prevent movement or warping.
10. Countersink fastener heads on exposed carpentry work and fill holes.

END OF SECTION 06 20 23

SECTION 06 41 16 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Custom plastic-laminate-clad architectural cabinets (one unit in kiosk).
2. Cabinet hardware and accessories.
3. Built in cubbies unit in office building.
4. Shelving in kiosks and storage rooms.
5. See drawings for size and configuration of built in units.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 12 32 16 "Manufactured Plastic Laminate Clad Casework" for pre-manufactured casework.
3. Section 12 36 61.19 "Quartz Agglomerate Countertops"

1.2 COORDINATION

- ##### A.
- Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 ACTION SUBMITTALS

- ##### A.
- Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
5. Apply AWI Quality Certification Program label to Shop Drawings.

1.4 INFORMATIONAL SUBMITTALS

- ##### A.
- Qualification Data: For manufacturer and Installer.

1.5 CLOSEOUT SUBMITTALS

- ##### A.
- Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
 - 1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program .
- B. Installer Qualifications: Licensed participant in AWI's Quality Certification Program .

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 20 and 50 percent during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. Provide certificates from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.
 - 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.
- B. Architectural Woodwork Standards Grade: Custom .
- C. Certified Wood: Verify wood products contain not less than 60 percent certified wood tracked through a chain-of-custody process. Provide certified wood documentation from sources certified through a forest certification system with principles, criteria, and standards developed

using ISO/IEC Guide 59 or the World Trade Organization's "WTO Agreement on Technical Barriers to Trade."

- D. Type of Construction: Frameless .
- E. Door and Drawer-Front Style: Flush overlay.
- F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Formica Corporation.
 - b. Laminart LLC.
 - c. Pionite; a Panolam Industries International, Inc. brand.
 - d. Wilsonart LLC.
- G. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS .
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: .
 - a. In cubbies: Grade HGS
 - b. In other cabinetry: Grade VGS
 - 4. Edges: Grade HGS .
 - 5. Pattern Direction: Horizontally for drawer fronts and fixed panels .
- H. Materials for Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS .
 - a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish,PVC T-mold matching laminate in color, pattern, and finish, or PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
 - 2. Drawer Sides and Backs: Solid-hardwood lumber .
 - 3. Drawer Bottoms: Hardwood plywood .
- I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners .
- J. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. Lower Cabinets Basis of Design Color: Formica Faux Gauze
 - 2. Upper Cabinets Basis of Design Color: Wilsonart Shadow
 - 3. Cubbies Basis of Design Color: Wilsonart Shadow
 - 4. Solid colors, matte finish.
 - 5. Solid colors with core same color as surface, matte finish.

2.2 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 71 00 "Door Hardware."
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Accuride International Inc.
 - b. Grass America.
 - c. Hardware Resources.
 - d. Hettich America L.P.
 - e. Knap & Vogt Manufacturing Company.
- B. Drawer and Cabinet Pulls: Back mounted, solid metal , 6 inches long, 1-1/4 inches deep, and 11/16 inch in diameter.
 - 1. Basis of Design: Amerock BP55277ORB
 - 2. Color/Finish: Oil Rubbed Bronze
 - 3. Hole Spacing: 5"
- C. Drawer Slides: ANSI/BHMA A156.9.
 - 1. Basis of Design: Accuride ST2800, Side-mount Roller-bearing slide.
 - 2. Heavy-Duty (Grade 1HD-200):Side mount .
 - a. Type: Full extension.
 - b. Material: Stainless steel slides.
 - c. Motion Feature: Gravity-activated self-closing mechanism.
- D. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- E. Door and Drawer Bumpers: Self-adhering, clear silicone rubber.
 - 1. Doors: Provide one bumper at top and bottom of closing edge of each swinging door.
 - 2. Drawers: Provide one bumper on back side of drawer front at each corner.
- F. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
 - 1. Dark, Oxidized, Satin Bronze, Oil Rubbed: ANSI/BHMA 613 for bronze base; ANSI/BHMA 640 for steel base; match Contracting Officer's sample.
- G. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.
- H. Adjustable Shelf Supports
 - 1. Adjustable Shelf Supports: Pin-type, two-pin-locking plastic shelf rests complying with ANSI/BHMA A156.9, Type B04013.

2.3 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Contracting Officer seven days in advance of the dates and times architectural cabinet fabrication will be complete.
 2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.4 PLASTIC LAMINATE CLAD SHELVING

- A. Shelves: Construction to comply with specifications described above for cabinetry.
- B. Hardware:
1. Heavy Duty Double-Slot Wall Standard - 16 gage steel; 1 1/4" side x 1/2" deep x length shown on drawings.
 2. Heavy Duty Double-Flange Brackets - 14-16 gage steel; shelf depths as shown on drawings.
 3. Hardware Finish: Powder-coated paint; white.
 4. Basis of Design: Knap & Vogt, 85 Series Standard and 185 Series Bracket System.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips ortoggle bolts through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 06 41 16

SECTION 07 11 13 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cold-applied, emulsified-asphalt dampproofing.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for vapor retarders under slabs-on-grade.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. APOC, Inc; a division of Gardner Industries.
 - 2. Brewer Company (The).
 - 3. ChemMasters, Inc.
 - 4. W. R. Meadows, Inc.
- B. Trowel Coats: ASTM D1227, Type II, Class 1.
- C. Fibered Brush and Spray Coats: ASTM D1227, Type II, Class 1.
- D. Brush and Spray Coats: ASTM D1227, Type III, Class 1.

2.3 AUXILIARY MATERIALS

- A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for surface smoothness, maximum surface moisture content, and other conditions affecting performance of the Work.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for dampproofing application.
- B. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- C. Clean substrates of projections and substances detrimental to dampproofing work; fill voids, seal joints, and remove bond breakers if any.
- D. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections.

3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing.
 - 1. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch- wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

3.4 INSTALLATION OF COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Concrete Foundations and Parged Masonry Foundation Walls: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat .
- B. Unexposed Face of Concrete Retaining Walls: Apply one brush or spray coat at not less than 1.25 gal./100 sq. ft..

- C. Unexposed Face of Masonry Retaining Walls: Apply primer and one brush or spray coat at not less than 1.25 gal./100 sq. ft..

3.5 PROTECTION

- A. Correct dampproofing that does not comply with requirements; repair substrates, and reapply dampproofing.
- B. Protect from damage when backfilling, particularly on retaining walls.

END OF SECTION 07 11 13

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Extruded polystyrene foam-plastic board insulation.
- 2. Glass-fiber board insulation.

- B. IECC REQUIREMENTS

- 1. Project Location: Larimer County, Colorado
- 2. Note: Elevation for ROMO Fall River Entrance is higher than most of Larimer County, so insulation has been increased beyond 5B minimum where space allows.
- 3. Climate Zone: 5B
- 4. Minimum Required Insulation Components per 2021 IECC:
 - a. Roof: Insulation in attic R-49
 - b. Walls, above grade: Wood Framed R-13 +R-7.5ci or R-20 + R-3.8ci
 - c. Walls, below grade: R-7.5ci
 - d. Slab-on-grade floors: Unheated, R-15 for 24" below.
- 5. Refer to Drawings for designed insulation depths.

- C. Related Requirements:

- 1. Section 07 21 19 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:

- 1. Extruded polystyrene foam-plastic board insulation.
- 2. Glass-fiber board insulation.

1.4 INFORMATIONAL SUBMITTALS

- A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 APPLICATIONS

- A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board
- B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board
- C. Insulation Over Wood Stud Framed Walls, Continuous: Extruded polystyrene (XPS) carbon black board
- D. Insulation on Inside of Concrete and Masonry Exterior Walls: Glass fiber board
- E. Insulation in Wood Framed Walls and Ceiling: Foamed in Insulation (re: Section 07 21 19 "Foamed-in-Place Insulation")

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

- A. Extruded Polystyrene Board Insulation, Type X Continuous Rigid Insulation : ASTM C578, Type X, 15-psi minimum compressive strength; unfaced.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Kingspan Insulation, CertiFoam
 - b. Owens Corning, Foamular NGX
 - c. Dupont, Styrofoam Cavitymate
 2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
 4. No use of hydrofluorocarbons (HFCs) in the blowing agents formulation due to high Global Warming Potential (GWP).
 5. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.3 GLASS-FIBER BOARD INSULATION

- A. Glass-Fiber Board Insulation, Unfaced : ASTM C612, Type IA; unfaced.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Certainteed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.

4. Nominal Density: 6 lb/cu. ft..
5. Thermal Resistivity: 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F.
6. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.4 ACCESSORIES

- A. Insulation for Miscellaneous Voids (see also Section 07 21 19):
 1. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer.
 1. Fit courses of insulation between obstructions, with edges butted tightly in both directions, and with faces flush.
 2. Press units firmly against inside substrates.
 3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 043400 "Stone Masonry."

3.4 INSTALLATION OF INSULATION INSIDE OF CONCRETE WALLS

- A. Glass-fiber Board: Install behind boardform concrete veneer as shown in drawings.
- B. Butt panels together for tight fit.
- C. Affix insulation boards temporarily to interior face of inside of concrete formwork.

- D. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
 - 1. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
 - 2. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation retaining washers.

3.5 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 21 19 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Closed-cell spray polyurethane foam insulation.
 - 2. Accessories.
- B. Related Requirements:
 - 1. Section 07 21 00 "Thermal Insulation" for foam-plastic board insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Submittals:
 - 1. Field quality-control reports.
- B. Qualification Statements: For Installer.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM INSULATION

- A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle Spray Foam Insulation.
 - b. Gaco; a brand of Firestone Building Products.
 - c. Johns Manville; a Berkshire Hathaway company.
 - d. NCFI Polyurethanes; a division of Barnhardt Manufacturing Company.
 - e. SES Foam LLC.
 - 2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 3. Fire Propagation Characteristics: Passes NFPA 285 and NFPA 276 testing as part of an approved assembly.

2.2 ACCESSORIES

- A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.
 - 1. Provide primer from same manufacturer as the foamed in place insulation.
- B. Ignition Barrier: Material providing a 15-minute minimum fire-ignition barrier.
 - 1. Gypsum Wallboard: 0.325-inch minimum thickness.
 - 2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
- B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Spray insulation to envelop entire area to be insulated and fill voids.
- C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
- D. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.
- E. Cavity Walls: Install into cavities to thickness indicated on Drawings .
- F. Miscellaneous Voids: Apply according to manufacturer's written instructions.
- G. Install ignition barrier material.
 - 1. Do not cover insulation prior to any required spray foam insulation inspections.
- H. Apply barrier coatings in accordance with manufacturer's written instructions and to comply with requirements for listing and labeling for fire-propagation characteristics and surface-burning characteristics specified.
 - 1. Use equipment and techniques best suited for substrate and type of material applied as recommended by coating manufacturer.
 - 2. Apply coatings to prepared surfaces as soon as practical after preparation and before subsequent surface soiling or deterioration.

3. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Produce sharp lines and color breaks.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect spray foam insulation installation, including accessories. Report results in writing.

3.4 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION 07 21 19

SECTION 07 25 00 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Building wrap.
 - 2. Flexible flashing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.
- B. Shop Drawings: Show details of building wrap at terminations, openings, and penetrations. Show details of flexible flashing applications.
- C. Mock-up: Show transitions and terminations of building wrap and flexible flashings in corner building mock. Refer to 04 34 00 "Stone Masonry" Mockup.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

- A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DuPont de Nemours, Inc.
 - b. Kingspan Insulation LLC.
 - c. Ludlow Coated Products.
 - d. The Dow Chemical Company.
 - e. Or Approved Equal.
 - 2. Allowable UV Exposure Time: Not less than three months.
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 FLEXIBLE FLASHING

- A. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 inch.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DuPont de Nemours, Inc.
 - b. GCP Applied Technologies Inc.
 - c. Protecto Wrap Company.
 - d. Or Approved Equal
- B. Primer for Flexible Flashing: Product recommended in writing by flexible flashing manufacturer for substrate.
- C. Nails and Staples: Product recommended in writing by flexible flashing manufacturer and complying with ASTM F 1667.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
 1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
 2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.
- C. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.
 1. Seal seams, edges, fasteners, and penetrations with tape.
 2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
 1. Prime substrates as recommended by flashing manufacturer.
 2. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
 3. Lap flashing over water-resistive barrier at bottom and sides of openings.
 4. Lap water-resistive barrier over flashing at heads of openings.
 5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 07 25 00

SECTION 07 41 13.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Standing-seam metal roof panels. (Base Bid)
 - 2. Weathering steel standing-seam metal roof panels (Bid Option 6)
 - 3. Roof accessories: snow guards
- B. Except for Bid Option 6 (weathering steel), roofing, soffit panels, and accessories are called out as aluminum or steel to allow flexibility for procurement and shifting construction costs.
 - 1. All elements are preferred to be the same metal to avoid galvanic action.
 - 2. If different metals are used, Contractor shall be responsible for coordination of gaskets and isolation materials to prevent galvanic action.
- C. Related Sections:
 - 1. Section 074293 "Soffit Panels" for metal panels used in horizontal soffit applications.
 - 2. Section 07 62 00 "Sheet Metal Flashing and Trim."

1.3 PREINSTALLATION MEETINGS

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Metal Panels: 12 inches long by actual panel width. Actual material, a representation of color is not acceptable. Include clips, fasteners, closures, and other metal panel accessories.
 - 2. Snow Guards: 8 inch minimum actual material sample to confirm matches metal panels

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.
- B. Warranties

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
- C. All metal accessories associated with roof shall match the roof panel color and material. (Both Base Bid and Bid Option 6)

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- B. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
 - 1. Hail Resistance: MH .

2.2 STANDING-SEAM METAL ROOF PANELS

- A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
 - 1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.
- B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels "Prefinished Metal Standing Seam Roofing" : Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips

located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Berridge Manufacturing Company (Basis of Design for base bid: Double-Lock Zee-Lock).
 - b. Bridger Steel (Basis of Design for Option 6: Mechanical Lock in Truten A606).
 - c. Firestone Building Products.
 - d. MBCI; Cornerstone Building Brands.
 - e. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
 - f. Western States Metal Roofing.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Nominal Thickness: 24 gage (steel) and 0.032 (aluminum).
 - b. Exterior Finish: Three-coat fluoropolymer .
 - c. Color: Dark Bronze.
3. Corten or Weathering Steel Sheet: Complying with ASTM 606-4.
 - a. Nominal Thickness: 20 to 22 gage.
 - b. Pre-patinated color: rust/Truten A606
4. Clips: to accommodate thermal movement.
 - a. Material: 0.064-inch- nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
5. Joint Type: Standing Rib, mechanically seamed.
6. Panel Coverage: 16 inches .
7. Seam height: 1-1/2" to 2" high
8. Panel Height: 2.0 inches .

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
 1. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.
 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle WIP Products; a brand of Carlisle Construction Materials.
 - b. GCP Applied Technologies Inc.
 - c. Owens Corning.
- B. Ice and Water Shield: provide self-adhered roofing underlayment composed of rubberized asphalt adhesive backed by slip resistant coated high density cross laminated polyethylene film.
 1. Manufacturer:
 - a. Provide ice and water shield from same manufacturer as underlayment or provide compatibility letter from both manufacturers establishing compatibility between products.
 - b. Basis of Design: GCP Applied Technologies, Grace Ice and Water Shield, or equal.

2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 - 2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.
- E. Snow guards: Provide snow guards at locations shown on drawings.
 - 1. Basis of Design: Alpine Snowguards, SnowMax-Standing Seam
 - 2. Type: "rail" or "bar" type with non-penetrating clamp attachments designed for use with standing seam metal roofing.
 - 3. Material: Steel or Aluminum (if material does not match roofing, provide gasket to prevent galvanic action)
 - 4. Color: Dark Bronze to match color of roof (Weathering steel snowguards for Bid Option 6). Color matching to be evaluated by Contracting Officer through submittal and approval of samples.

2.5 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
 - 1. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 - 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF UNDERLAYMENT

- A. Ice and Water Shield: Install ice and water shield directly on clean, dry, continuous structural deck. Follow manufacturer's recommended installation method, including recommended laps. Install membrane such that all laps shed water. Apply membrane in valleys before membrane is applied to eaves. Cover within 90 days or within manufacturer's recommended maximum exposure time (whichever is less).
 - 1. Apply over the entire roof surface.
- B. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply over the entire roof surface.
- C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07 62 00 "Sheet Metal Flashing and Trim."

3.4 INSTALLATION OF STANDING SEAM METAL ROOF PANELS

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor

metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing

hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.5 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 41 13.16

SECTION 07 42 93 - SOFFIT PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal soffit panels.
- B. Except for Bid Option 6 (weathering steel), roofing, soffit panels, and accessories are called out as aluminum or steel to allow flexibility for procurement and shifting construction costs.
 - 1. In both cases, soffit panels shall match the roofing material to avoid extensive gasketing.
- C. Related Sections:
 - 1. Section 07 41 13.16 "Standing Seam Metal Roof Panels" standing seam metal roofing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Selection Confirmation: For each type of metal panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
 - 2. Provide actual product samples, not a brochure or simulation.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.7 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.8 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft. .
- B. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft. .
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F , ambient; 180 deg F , material surfaces .

2.2 METAL SOFFIT PANELS

- A. Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Flush-Profile Metal Soffit Panels : Solid panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with flush joint between panels.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Berridge Manufacturing Company.
 - b. Fabral; a brand of OmniMax International.
 - c. Firestone Building Products.
 - d. MBCI; Cornerstone Building Brands.
 - e. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
 - f. Or Approved Equal.
 - 2. Material:
 - a. For base bid: Same material, finish, and color as metal roof panels.
 - b. For Bid Option 6: Prefinished steel panels in Dark Bronze.
 - 3. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Nominal Thickness: 0.028 inch .
 - b. Exterior Finish: Three-coat fluoropolymer .
 - c. Basis of Design Color: Dark Bronze.
 - 4. Panel Coverage: 12 inches.
 - 5. Panel Height: 0.875 inch to 1.0 inch.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- D. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
 1. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.
 - 2. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.
 - a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.
 - 1. Soffit Framing: Wire tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 INSTALLATION

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 6. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 - 1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
 - 2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 - 1. Apply panels and associated items true to line for neat and weathertight enclosure.
 - 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 - 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 - 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
- E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
 - 1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 93

SECTION 07 46 46 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes fiber-cement siding .
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wood furring, grounds, nailers, and blocking.
 - 2. Section 07 25 00 "Weather Barriers" for weather-resistive barriers.

1.3 COORDINATION

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples for Initial Selection: For fiber-cement siding including related accessories.
 - 1. Samples to be pieces of the actual product and not simulated representations of the finish.

1.6 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish full lengths of fiber-cement siding including related accessories, in a quantity equal to 5 percent of amount installed.

1.9 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Build mockups for fiber-cement siding including accessories.
 - a. Size: 48 inches long by 60 inches high minimum.
 - b. Include outside corner on one end of mockup and inside corner on other end.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Contracting Officer specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements and with prior approval of the Contracting Officer, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracking and deforming.
 - b. Deterioration of materials beyond normal weathering.
 - 2. Warranty Period (siding): 30 years from date of Substantial Completion for siding.
 - 3. Warranty Period (trim): 15 years from date of Substantial Completion for trim products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

2.2 FIBER-CEMENT SIDING

- A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. James Hardie Building Products, Inc. (Basis of Design)
 - b. Or Approved Equal.
- B. Nominal Thickness: Not less than 5/16 inch.
- C. Horizontal Trim Boards: Dimensions as indicated on the drawings. style.

1. Texture: Wood grain .
 - D. Vertical Pattern: 48-inch-wide sheets with wood-grain texture and vertical/batten trim installed over it.
 1. Battens: 1x3 trim, vertically oriented, 16" o.c.
 - E. Prefinished color: Custom to match Benjamin Moore Aura "Historic Dark Brown".
- 2.3 ACCESSORIES
- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
 1. Provide accessories matching color and texture of adjacent siding.
 - B. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated:
 1. Fasciae.
 2. Moldings and trim.
 - C. Flashing: Provide aluminum or stainless-steel flashing complying with Section 07 62 00 "Sheet Metal Flashing and Trim" at window and door heads as shown on the Drawings.
 - D. Fasteners:
 1. For fastening to wood, use siding nails of sufficient length to penetrate a minimum of 1 inch into substrate.
 2. For fastening fiber cement, use stainless-steel fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement siding and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
 1. Do not install damaged components.
 2. Install fasteners no more than 24 inches o.c.
- B. Install joint sealants as specified in Section 07 92 00 "Joint Sealants" and to produce a weathertight installation.

3.4 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 07 46 46

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Manufactured reglets.
 - 2. Formed steep-slope roof sheet metal fabrications.
 - 3. Formed wall sheet metal fabrications.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wood nailers and blocking.
 - 2. Section 074113.16 " Standing-Seam Metal Roof Panels " for materials and installation of sheet metal flashing and trim integral with roofing.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each of the following
 - 1. Elastomeric sealant.
 - 2. Butyl sealant.
 - 3. Epoxy seam sealer.
- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include identification of material, thickness, weight, and finish for each item and location in Project.
 - 3. Include details for forming, including profiles, shapes, seams, and dimensions.
 - 4. Include details of connections to adjoining work.
 - 5. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches .
- C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.
- D. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
 - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 - 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation or aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 coating designation, Grade 40; prepainted by coil-coating process to comply with ASTM A755/A755M.
 - 1. Surface: Smooth, flat and with manufacturer's standard clear acrylic coating on both sides.
 - 2. Exposed Coil-Coated Finish:
 - a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 3. Color: As selected by Contracting Officer from manufacturer's full range. Typically to match adjacent metals or finishes (roofing, metal soffit, window frame, etc).
 - 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
 - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- C. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- D. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cheney Flashing Company.
 - b. Fry Reglet Corporation.
 - c. Hohmann & Barnard, Inc.
 - d. Keystone Flashing Company, Inc.
 - e. Metal-Era, Inc.
 - f. Or Approved Equal.
 - 2. Source Limitations: Obtain reglets from single source from single manufacturer.
 - 3. Material: Stainless steel, 0.0188 inch thick or Aluminum, 0.024 inch thick depending on adjacent materials. Avoid galvanic action by selecting similar materials.
 - 4. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 - 5. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
 - 6. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 - 7. Accessories:
 - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
 - 8. Finish: With manufacturer's standard color coating as selected by Contracting Officer .

2.4 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
 - 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
 - 4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
 - 1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
 - 2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- G. Seams:
 - 1. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
- H. Do not use graphite pencils to mark metal surfaces.

2.5 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

2.6 WALL SHEET METAL FABRICATIONS

- A. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 8 inches beyond wall openings. Form head and sill flashing with 8-inch- high, end dams. Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch thick.

2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
 - 1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
 - 3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 - 5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
 - 6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 - 8. Do not field cut sheet metal flashing and trim by torch.
 - 9. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
 - 1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws .
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
 - a. Form joints to completely conceal sealant.
 - b. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
 - c. Adjust setting proportionately for installation at higher ambient temperatures.
 - 1) Do not install sealant-type joints at temperatures below 40 deg F.
 2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

3.3 INSTALLATION OF WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 8 inches beyond wall openings.
- C. Reglets: Installation of reglets as shown on Drawings.

3.4 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.5 CLEANING

- A. Clean off excess sealants.

3.6 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.

- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by the Contracting Officer.

END OF SECTION 07 62 00

SECTION 07 92 00 - JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware: Setting exterior door thresholds in sealant.
- C. Section 09 29 00 - Gypsum Board: Sealing acoustical and sound-rated walls and ceilings.
- D. Section 09 30 13 – Ceramic Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

1.03 REFERENCE STANDARDS

- A. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2018.
- B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- C. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- E. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2018.
- F. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.
- G. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019.
- H. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

- E. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

1.05 QUALITY ASSURANCE

- A. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 - 1. Adhesion Testing: In accordance with ASTM C794.
 - 2. Compatibility Testing: In accordance with ASTM C1087.
 - 3. Allow sufficient time for testing to avoid delaying the work.
 - 4. Deliver to manufacturer sufficient samples for testing.
 - 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
 - 6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

- A. Scope:
 - 1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
 - 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. Other joints indicated below.
 - 3. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
- B. Exterior Joints – Vertical Surfaces:
 - 1. Silicone or urethane.

2. ASTM C920, Type S, Grade NS, Class 25, Use M, A, or O, as applicable.
- C. Exterior Joints – Horizontal Surfaces:
1. Urethane.
 2. ASTM C920, Type S or M, Grade P, Class 25, Use T.
 3. Grade NS, Use T, in areas with slopes exceeding 1 percent.
- C. Interior Joints - Vertical:
1. Silicone or urethane
 2. ASTM C920, Type S, Grade NS, Class 25, Use M, A, or O, as applicable
- D. Interior Joints - Horizontal Surfaces in Traffic Areas:
1. Urethane
 2. ASTM C920, Type S or M, Grade P, Class 25, Use T
 3. Grade NS, Use T, in areas with slopes exceeding 1 percent
- E. Interior Joints - Horizontal Surfaces in Nontraffic Areas:
1. ASTM C920, Type S, Grade P, Class 25, Use NT
 2. Grade NS, Use NT, in areas with slopes exceeding 1 percent
- F. Vertical and Horizontal Surfaces in Humid Areas: ASTM C920, Type S, Grade NS, Class 12-1/2, Use O.
- G. Vertical and Horizontal Surfaces, Dry Areas Only, No Movement Anticipated: Single component water-based latex, paintable, ASTM C834.

2.02 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

2.03 NONSAG JOINT SEALANTS

- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Max. limits determined by the joint sealer manufacturer.
 2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
- B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Color: As selected by Contracting Officer from manufacturer's standard range.
- C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi component, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Max. limits determined by the joint sealer manufacturer.

2.04 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.

2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
 3. Open Cell: 40 to 50 percent larger in diameter than joint width.
 4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
- B. Overlay Extrusion for Glazing System Joint Protection: Rubber profiled extrusions placed over joints in glazing system and provided with watertight seal.
1. Profile: As required to match existing metal glazing cap requirements.
 2. Color: As required to match existing conditions.
- C. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- D. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- E. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Install bond breaker backing tape where backer rod cannot be used.
- D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Exterior insulated steel doors and frames.
- B. Related Requirements:
 - 1. Section 08 52 00 "Wood Windows" for privacy film to apply to interior side of lite. Re: Door Schedule on drawings for locations.
 - 2. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.
 - 3. Section 12 24 13 "Window Shades" for interior side applied shades for hollow-metal doors with lites.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Details of moldings, removable stops, and glazing.
- C. Samples for Initial Selection: For hollow-metal doors and frames with factory-applied color finishes. Custom Color, to match existing Bighorn Ranger Station.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.

- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ceco Door; AADG, Inc.; ASSA ABLOY.
 - 2. Colorado Doorways.
 - 3. Curries, AADG, Inc.; ASSA ABLOY Group.
 - 4. DCI Hollow Metal on Demand.
 - 5. Deansteel Manufacturing Company, Inc.
 - 6. Steelcraft; Allegion plc.
 - 7. Or Approved Equal.
- B. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ceco Door, Assa Abloy

2.2 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A. at Exterior Doors.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Edge Construction: Model 1, Full Flush .
 - d. Edge Bevel: Bevel lock edge 1/8 inch in 2 inches Provide manufacturer's standard beveled or square edges.
 - e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - f. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - g. Core: Manufacturer's standard .
 - h. For doors with glazing:
 - 1) Refer to Drawings for basis of design lite size and configuration.
 - 2) Glazing frame: flush
 - 2. Frames:

- a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
- b. Construction: Full profile welded.
3. Exposed Finish: Factory.
4. Color: Custom Color, to match "Benjamin Moore Aura - Mint Green".

2.3 FRAME ANCHORS

- A. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.4 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing:
 1. Insulated glazing unit.

2.5 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
 - 1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
 - 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 - 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.6 STEEL FINISHES

- A. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with ANSI/SDI A250.3.
 - 1. Color and Gloss: As selected by Contracting Officers from manufacturer's full range.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11 .
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.

- b. Install frames with removable stops located on secure side of opening.
- 2. Floor Anchors: Secure with postinstalled expansion anchors.
- 3. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
- 4. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Glazing: Comply with installation requirements with hollow-metal manufacturer's written instructions.

3.3 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 13

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid core, five-ply flush wood veneer-faced doors for transparent finish.
- B. Related Requirements:
 - 1. Section 09 93 00 "Staining and Transparent Finishing" for field finishing doors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
 - 1. Door core materials and construction.
 - 2. Door edge construction
 - 3. Door face type and characteristics.
 - 4. Door louvers.
 - 5. Door trim for openings.
 - 6. Door frame construction.
 - 7. Factory-machining criteria.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:
 - 1. Door schedule indicating door and frame location, type, size, and swing.
 - 2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
 - 3. Details of frame for each frame type, including dimensions and profile.
 - 4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 - 5. Dimensions and locations of blocking for hardware attachment.
 - 6. Dimensions and locations of mortises and holes for hardware.
 - 7. Clearances and undercuts.
 - 8. Requirements for veneer matching.
 - 9. Apply AWI Quality Certification Program label to Shop Drawings.

1.3 CLOSEOUT SUBMITTALS

- A. Special warranties.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons, and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.5 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.
2. Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors and frames that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Delamination of veneer.
 - b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors and frames.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- #### A. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

2.3 FLUSH WOOD DOORS AND FRAMES, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Provide labels from AWI certification program indicating that doors and frames comply with requirements of grades specified.

B. Regional Materials: Manufacture wood doors within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If transporting materials by rail or water, multiply the distance transported by rail or water by 0.25 to determine the distance to Project site.

C. Certified Wood: Verify wood doors contain not less than 60 percent certified wood tracked through a chain-of-custody process. Provide certified wood documentation from sources certified through a forest certification system with principles, criteria, and standards developed using ISO/IEC Guide 59 or the World Trade Organization's "Technical Barriers to Trade."

D. Adhesives: Do not use adhesives that contain urea formaldehyde.

E. Composite Wood Products: Verify products are made without added urea formaldehyde.

2.4 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Doors, Solid-Core Five-Ply Veneer-Faced :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lambton Doors.
 - b. Masonite Architectural.
 - c. Oregon Door Company, Architectural Series.
 - d. Oshkosh Door Company.
 - e. VT Industries, Inc.
 - f. Or Approved Equal.
2. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty .
3. Architectural Woodwork Standards ANSI/WDMA I.S. 1A Grade: Custom.
4. Faces: Single-ply wood veneer not less than 1/50 inch thick.
 - a. Species: Fir.
 - b. Cut: Plain sliced (flat sliced) .
 - c. Match between Veneer Leaves: Book match.
5. Core for Non-Fire-Rated Doors:
 - a. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
6. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.5 LOUVERS

A. Metal Louvers:

1. Refer to mechanical louver schedule for specified louver.

2.6 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

B. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 08 71 00 "Door Hardware."
- B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
 - 1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
 - 2. Anchor frames to anchors or blocking built in or directly attached to substrates.
 - a. Secure with countersunk, concealed fasteners and blind nailing.
 - b. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork.
- D. Job-Fitted Doors:
 - 1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
 - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
 - 2. Machine doors for hardware.
 - 3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 4. Clearances:
 - a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
 - b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
 - c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
- E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 14 16

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Access doors and frames.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details material descriptions, dimensions of individual components and profiles, and finishes.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Concealed Flanges :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACUDOR Products, Inc.
 - b. Babcock-Davis.
 - c. Elmdor; Morris Group International, Inc.
 - d. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - e. Karp Associates, Inc.
 - f. Metropolitan Door Industries Corp.
 - g. MIFAB, Inc.
 - h. Milcor; Hart & Cooley, Inc.
 - i. Nystrom, Inc.
 - j. Williams Bros. Corporation of America (The).
 - k. Or Approved Equal.
 2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
 3. Optional Features: Gasketing .
 4. Locations: Wall .
 5. Door Size: Refer to Drawings for Door Size(s) .
 6. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch , 16 gage factory finished.
 7. Frame Material: Same material and thickness as door .
 8. Latch and Lock: Cam latch, hex-head wrench operated .

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304 . Remove tool and die marks and stretch lines, or blend into finish.
- E. Stainless Steel Flat Bars: ASTM A666, Type 304 . Remove tool and die marks and stretch lines, or blend into finish.
- F. Aluminum Extrusions: ASTM B221, Alloy 6063.
- G. Aluminum Sheet: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- H. Frame Anchors: Same material as door face.
- I. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - I. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
- D. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.4 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil for topcoat.
 - a. Color: As selected by Contracting Officer from full range of industry colors .

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 31 13

SECTION 08 52 00 – METAL CLAD WOOD WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes aluminum-clad wood windows.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for wood windows.
- B. Shop Drawings: For wood windows.
 - 1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified, 2 by 4 inches in size.

1.4 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. Warranty Period:
 - a. Window: 10 years from date of Substantial Completion.
 - b. Glazing Units: 20 years from date of Substantial Completion.
 - c. Aluminum-Cladding Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wood windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - 1. Window Certification: WDMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
 - 1. Minimum Performance Class: AW.
 - 2. Minimum Performance Grade: 50 .
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.35 Btu/sq. ft. x h x deg F .
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40 .

2.3 WOOD WINDOWS

- A. Aluminum-Clad Wood Windows:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Andersen Windows, Inc.; Andersen Corporation.
 - b. JELD-WEN, Inc.
 - c. Marvin Windows and Doors.
 - d. Pella Corporation.
- B. Operating Types: Provide the following operating types in locations indicated on Drawings:
 - 1. Single hung.
 - 2. Horizontal sliding.
 - 3. Fixed.
- C. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch deep by 2 inches wide; water-repellent preservative treated.
 - 1. Exterior Finish: Aluminum-clad wood.
 - a. Aluminum Finish: Manufacturer's standard fluoropolymer two-coat system with fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight and complying with AAMA 2605 .
 - 2. Exterior Color: Custom Color, to match "Benjamin Moore Aura - Mint Green".
 - 3. Interior Finish:
 - a. Color: Unfinished wood, ready to receive stain.
 - b. See Section 09 93 00 "Staining and Transparent Finishes" for stain.
- D. Insulating-Glass Units: ASTM E 2190.
 - 1. Glass: ASTM C 1036, Type 1, Class 1, q3.
 - a. Tint: Clear or Frosted, as indicated on Window Schedule.
 - b. Kind: Fully tempered where indicated on Drawings .
 - 2. Lites: Two.
 - 3. Filling: Fill space between glass lites with air .
 - 4. Low-E Coating: Pyrolytic on second surface .

5. Frosted: At locations indicated to be frosted provide sandblasted finish on third surface. Opacity shall be 100%.
- E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
 - F. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
 1. Exposed Hardware Color and Finish: As selected by Contracting Office from manufacturer's full range. Design intent is to match exterior window frame color..
 - G. Hung Window Hardware:
 1. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
 - H. Horizontal-Sliding Window Hardware:
 1. Sill Cap/Track: Manufacturer's standard of dimensions and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.
 2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
 3. Roller Assemblies: Low-friction design.
 - I. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
 - J. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
 1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

- A. Privacy Film: At all locations identified on the Window Schedule provide privacy film on the interior (fourth) surface.
 1. Basis of Design: 3M Sun Control Window Films, Night Vision 15
 2. Scratch Resistant
 3. U Value: 0.98
 4. Visible Light Transmittance: 0.15
 5. Solar Heat Gain Coefficient: 0.28
 6. Visible Reflection:
 - a. Exterior: 0.38
 - b. Interior: 0.11
 7. Manufacturer's Comprehensive Warranty: 12 years, minimum.

2.5 INSECT SCREENS

- A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.
 1. Type and Location: Full, outside for sliding sashes.

- B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
 - 1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.
 - 2. Finish for Interior Screens: Baked-on organic coating in color selected by Contracting Officer from manufacturer's full range, design intent is to match aluminum window finish color.
 - 3. Finish for Exterior Screens: Matching color and finish of claddingBaked on organic coating in color selected by Contracting Officer from manufacturer's full range. Design intent is to match window frame color..
- C. Aluminum Wire Fabric: 18-by-16 mesh of 0.011-inch- diameter, coated aluminum wire.
 - 1. Wire-Fabric Finish: Charcoal gray .

2.6 FABRICATION

- A. Fabricate wood windows in sizes indicated. Include a complete system for installing and anchoring windows.
- B. Glaze wood windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- B. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.
 - 1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 08 52 00

SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:
 - a. Swinging doors.
2. Electronic access control system components – for card reader locations, coordinate with technology design (drawings and specifications).

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories

C. Related Sections:

1. Division 01 Section “Submittal Procedures”
2. Division 06 Section “Rough Carpentry”
3. Division 06 Section “Finish Carpentry”
4. Division 07 Section “Joint Sealants” for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
 - a. “Metal Doors and Frames”
 - b. “Flush Wood Doors”
6. Division 26 “Electrical” sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 “Electronic Safety and Security” sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

B. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
 - a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Door Hardware Schedule:
 - a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
 - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
 - c. Indicate complete designations of each item required for each opening, include:
 - 1) Door Index: door number, heading number, and hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.

- 4) Fastenings and other pertinent information.
- 5) Location of each hardware set cross-referenced to indications on Drawings.
- 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
- 7) Mounting locations for hardware.
- 8) Door and frame sizes and materials.
- 9) Degree of door swing and handing.
- 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

4. Key Schedule:

- a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
- b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
- c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
- d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
- e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Contracting Officer, by means as directed by Contracting Officer.
- f. Prepare key schedule by or under supervision of supplier, detailing Contracting Officer's final keying instructions for locks.

5. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

C. Informational Submittals:

1. Provide Product Data:

- a. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

- a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
- b. Catalog pages for each product.
- c. Name, address, and phone number of local representative for each manufacturer.
- d. Final approved hardware schedule edited to reflect conditions as installed.
- e. Final keying schedule
- f. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
- g. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Contracting Officer and Contractor, at reasonable times during the Work for consultation.
 - a. Warehousing Facilities: In Project's vicinity.
 - b. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - c. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies like those indicated for this Project.
 - d. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Contracting Officer and provide installation and technical data to related subcontractors.
 - 1) Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - a. For door hardware: DHI certified AHC or DHC.
 - b. Can provide installation and technical data to Contracting Officer and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.
 - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Contracting Officer.
4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Electrified Door Hardware
 - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
2. Accessibility Requirements:
 - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference

- a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.

2. Pre-installation Conference

- a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- b. Inspect and discuss preparatory work performed by other trades.
- c. Inspect and discuss electrical roughing-in for electrified door hardware.
- d. Review sequence of operation for each type of electrified door hardware.
- e. Review required testing, inspecting, and certifying procedures.
- f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:

- a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

1.06 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with security contractor.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
 - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
 - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
 - a. Mechanical Warranty
 - 1) Locks
 - a) Falcon: 10 year
 - 2) Closers
 - a) Falcon SC Series: 10 year

1.08 MAINTENANCE

- A. Turn over unused materials to Contracting Officer for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- B. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Contracting Officer's approval.

2.02 MATERIALS

A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Contracting Officer if thru bolts are required.
4. Install hardware with fasteners provided by hardware manufacturer.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Basis of Design: Ives 5BB series
2. Acceptable Manufacturers and Products:
 - a. McKinney TB/T4B series
 - b. Stanley FBB series
 - c. Or Approved Equal

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins

2.04 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Basis of Design: Falcon T series
2. Acceptable Manufacturers and Products:
 - a. Corbin-Russwin CL3300 series
 - b. Sargent 10-Line
 - c. Or Approved Equal

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
 - a. Lever Design: Dane.

2.05 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Basis of Design: Von Duprin 6000 Series.
2. Acceptable Manufacturers and Products:
 - a. Folger Adam 300 Series
 - b. HES 1006 Series
 - c. Or Approved Equal

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant that are tested to a minimum endurance test of 1,000,000 cycles.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.06 CYLINDERS

1. Manufacturers:

- a. Scheduled Manufacturer and Product:
 - 1) To be provided by Government.
- b. Acceptable Manufacturers and Products:
 - 1) No Substitute

2. Requirements:

- a. Provide permanent or interchangeable cylinders/cores to match Government's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.07 KEYING

A. Scheduled System:

1. Existing factory registered system:
 - a. Provide cylinders/cores keyed into Government's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - a. Master Keying system as directed by the Contracting Officer.
2. Forward biting list and keys separately from cylinders, by means as directed by Contracting Officer. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Government.
3. Provide keys with the following features:
 - a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - b. Patent Protection: Keys and blanks protected by one or more utility patent(s).
4. Identification:
 - a. Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
 - b. Identification stamping provisions must be approved by the Contracting Officer.
 - c. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Government.
 - d. Forward permanent cylinders/cores to Contracting Officer, separately from keys, by means as directed by Contracting Officer.
5. Quantity: Furnish in the following quantities.
 - a. Change (Day) Keys: 2 per cylinder/core.
 - b. Master Keys: 6.

2.08 DOOR CLOSERS (EXTERIOR)

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Basis of Design: Falcon SC70A series
2. Acceptable Manufacturers and Products:
 - a. LCN 4050 series
 - b. Norton 7500 series
 - c. Sargent 351 series
 - d. Or Approved Equal

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with aluminum cylinder.

3. Closer Body: 1-1/2-inch (38 mm) diameter with 5/8-inch (16 mm) diameter heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.09 DOOR CLOSERS (INTERIOR)

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Basis of Design: Falcon SC80A series
2. Acceptable Manufacturers and Products:
 - a. LCN 1450 series
 - b. Norton 8000 series
 - c. Sargent 1331 series
 - d. Or Approved Equal

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory.
2. Provide door closers with fully hydraulic, full rack and pinion action with aluminum cylinder.
3. Closer Body: 1-1/4-inch (32 mm) diameter, with 5/8-inch (16 mm) diameter heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.10 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:

- a. Basis of Design: Ives
- 2. Acceptable Manufacturers:
 - a. Burns
 - b. Rockwood
 - c. Or Approved Equal.

B. Requirements:

- 1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
- 2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
- 3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.11 DOOR STOPS AND HOLDERS

A. Manufacturers:

- 1. Scheduled Manufacturer:
 - a. Basis of Design: Ives
- 2. Acceptable Manufacturers:
 - a. Burns
 - b. Rockwood
 - c. Or Approved Equal.

B. Provide door stops at each door leaf:

- 1. Provide wall stops wherever possible. Provide concave type where lockset has a push button or thumbturn.
- 2. Where a wall stop cannot be used, provide universal floor stops.
- 3. Where wall or floor stop cannot be used, provide overhead stop.
- 4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.12 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

- 1. Scheduled Manufacturer:
 - a. Basis of Design: Zero International
- 2. Acceptable Manufacturers:
 - a. National Guard

- b. Pemko
- c. Or Approved Equal.

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.13 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Basis of Design: Ives
2. Acceptable Manufacturers:
 - a. Burns
 - b. Rockwood
 - c. Or Approved Equal.

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.14 FINISHES

- A. Finish: As specified in the hardware sets.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
 - 4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- H. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed in Drawings.
 - 5. Connections to panel interface modules, controllers, and gateways.
 - 6. Testing and labeling wires with opening number in Drawings.
- I. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Contracting Officer.

- J. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- K. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- L. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- M. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the Contracting Officer with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:

Hardware Group No. 01

For use on Door #(s):

101 Storage (Ext Door) 104 Mech Room

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>		<u>FINIS</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	•	613	IVE
1	EA	STOREROOM LOCK	T581 (CYLINDER PREP AS REQ'D) DANE	•	613	FAL
1	EA	PERMANENT CORE	PROVIDED BY GOVERNMENT			
1	EA	ELECTRIC STRIKE	6211 FSE 12/16/24/28 VAC/VDC	• ~	613	VON
1	EA	SURFACE CLOSER (W/ SPRING STOP)	SC71A SS	•	695	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	•	695	IVE
1	SET	GASKETING SET	429D @ HEAD & JAMBS	•	D	ZER
1	EA	DOOR SWEEP	39D	•	D	ZER
1	EA	SADDLE THRESHOLD	1/2" HIGH - WIDTH AS REQUIRED BY SILL DETAIL	•	A	ZER
1		LOW VOLTAGE POWER	PROVIDED BY DIVISION 28	~		
1	EA	MULTITECH READER	PROVIDED BY DIVISION 28 - MTB11 / MTB15 OR AS REQ'D - 5VDC - 28VDC	• ~	BLK	SCE
1	SET	WIRING, PT TO PT DIAGRAM & ELEVATION DIAGRAM	PROVIDED BY HARDWARE SUPPLIER	~		

[104: CHANGE TO OUT-SWINGING]

FREE EGRESS AT ALL TIMES.

KEY IN OUTSIDE TRIM RETRACTS LATCH FOR ENTRY ONLY. DOOR RE-SECURES WHEN KEY IS REMOVED.

AUTHORIZED CREDENTIAL MOMENTARILY RELEASES STRIKE ALLOWING ENTRY. ON LOSS OF POWER, ELECTRIFIED HARDWARE IS DISABLED. DOOR IS POSITIVELY LATCHED AND TRIM REMAINS SECURE.

Hardware Group No. 02

For use on Door #(s):

102 Ext Storage 109A Kiosk 109B Kiosk 109C Kiosk

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>		<u>FINIS</u>	<u>MFR</u>
<u>Y</u>					<u>H</u>	
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	•	613	IVE
1	EA	STOREROOM LOCK	T581 (CYLINDER PREP AS REQ'D) DANE	•	613	FAL
1	EA	PERMANENT CORE	PROVIDED BY GOVERNMENT			
1	EA	ELECTRIC STRIKE	6211 FSE 12/16/24/28 VAC/VDC	• ~	613	VON
1	EA	SURFACE CLOSER (W/ STOP)	SC71A DS	•	695	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	•	695	IVE
1	SET	GASKETING SET	429D @ HEAD & JAMBS	•	D	ZER
1	EA	DOOR SWEEP	39D	•	D	ZER
1	EA	SADDLE THRESHOLD	1/2" HIGH - WIDTH AS REQUIRED BY SILL DETAIL	•	A	ZER
1		LOW VOLTAGE POWER	PROVIDED BY DIVISION 28	~		
1	EA	MULTITECH READER	PROVIDED BY DIVISION 28 - MTB11 / MTB15 OR AS REQ'D - 5VDC - 28VDC	• ~	BLK	SCE
1	SET	WIRING, PT TO PT DIAGRAM & ELEVATION DIAGRAM	PROVIDED BY HARDWARE SUPPLIER	~		

[OPENINGS 109A/B/C - PROVIDE PRIVACY FILM ON INT FACE OF LIGHT]

FREE EGRESS AT ALL TIMES.

KEY IN OUTSIDE TRIM RETRACTS LATCH FOR ENTRY ONLY. DOOR RE-SECURES WHEN KEY IS REMOVED.

AUTHORIZED CREDENTIAL MOMENTARILY RELEASES STRIKE ALLOWING ENTRY. ON LOSS OF POWER, ELECTRIFIED HARDWARE IS DISABLED. DOOR IS POSITIVELY LATCHED AND TRIM REMAINS SECURE.

Hardware Group No. 03

For use on Door #(s):

100 Office Entry 103 Break Room

Provide each SGL door(s) with the following:

<u>QT</u> <u>Y</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>		<u>FINIS</u> <u>H</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5	•	613	IVE
1	EA	STOREROOM LOCK	T581 (CYLINDER PREP AS REQ'D) DANE	•	613	FAL
1	EA	PERMANENT CORE	PROVIDED BY GOVERNMENT			
1	EA	ELECTRIC STRIKE	6211 FSE 12/16/24/28 VAC/VDC	• ~	613	VON
1	EA	SURFACE CLOSER	SC71A RW/PA	•	695	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	•	695	IVE
1	EA	WALL STOP	WS406/407 (CCV OR CVX AS REQ'D)	•	613	IVE
1	SET	GASKETING SET	429D @ HEAD & JAMBS	•	D	ZER
1	EA	DOOR SWEEP	39D	•	D	ZER
1	EA	SADDLE THRESHOLD	1/2" HIGH - WIDTH AS REQUIRED BY SILL DETAIL	•	A	ZER
1		LOW VOLTAGE POWER	PROVIDED BY DIVISION 28	~		
1	EA	MULTITECH READER	PROVIDED BY DIVISION 28 - MTB11 / MTB15 OR AS REQ'D - 5VDC - 28VDC	• ~	BLK	SCE
1	SET	WIRING, PT TO PT DIAGRAM & ELEVATION DIAGRAM	PROVIDED BY HARDWARE SUPPLIER	~		

PROVIDE PRIVACY FILM ON INT FACE OF LIGHT

FREE EGRESS AT ALL TIMES.

KEY IN OUTSIDE TRIM RETRACTS LATCH FOR ENTRY ONLY. DOOR RE-SECURES WHEN KEY IS REMOVED.

AUTHORIZED CREDENTIAL MOMENTARILY RELEASES STRIKE ALLOWING ENTRY. ON LOSS OF POWER, ELECTRIFIED HARDWARE IS DISABLED. DOOR IS POSITIVELY LATCHED AND TRIM REMAINS SECURE.

Hardware Group No. 04

For use on Door #(s):

108 Private Office

Provide each SGL door(s) with the following:

<u>QT</u> <u>Y</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>		<u>FINIS</u> <u>H</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	•	640	IVE
1	EA	STOREROOM LOCK	T581 (CYLINDER PREP AS REQ'D) DANE	•	613	FAL
1	EA	PERMANENT CORE	PROVIDED BY GOVERNMENT			
1	EA	ELECTRIC STRIKE	6211 FSE 12/16/24/28 VAC/VDC	• ~	613	VON
1	EA	SURFACE CLOSER	SC81A RW/PA FC	•	695	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	•	695	IVE
1	EA	WALL STOP	WS406/407 (CCV OR CVX AS REQ'D)	•	613	IVE
3	EA	SILENCER	SR64	•	GRY	IVE
1		LOW VOLTAGE POWER	PROVIDED BY DIVISION 28	~		
1	EA	MULTITECH READER	PROVIDED BY DIVISION 28 - MTB11 / MTB15 OR AS REQ'D - 5VDC - 28VDC	• ~	BLK	SCE
1	SET	WIRING, PT TO PT DIAGRAM & ELEVATION DIAGRAM	PROVIDED BY HARDWARE SUPPLIER	~		

FREE EGRESS AT ALL TIMES.

KEY IN OUTSIDE TRIM RETRACTS LATCH FOR ENTRY ONLY. DOOR RE-SECURES WHEN KEY IS REMOVED.

AUTHORIZED CREDENTIAL MOMENTARILY RELEASES STRIKE ALLOWING ENTRY. ON LOSS OF POWER, ELECTRIFIED HARDWARE IS DISABLED. DOOR IS POSITIVELY LATCHED AND TRIM REMAINS SECURE.

Hardware Group No. 05

For use on Door #(s):

106 Restroom

Provide each SGL door(s) with the following:

<u>QT</u> <u>Y</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>		<u>FINIS</u> <u>H</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	•	640	IVE
1	EA	DORMITORY LOCK	T571 (CYLINDER PREP AS REQ'D) DANE	•	613	FAL
1	EA	PERMANENT CORE	PROVIDED BY GOVERNMENT			
1	EA	SURFACE CLOSER (W/ STOP)	SC81A DS FC	•	695	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	•	695	IVE
1	EA	GASKETING	488S @ HEAD & JAMBS	•	BK	ZER

Hardware Group No. 06

For use on Door #(s):

101A Storage (Int Door) 105 Elec/IT

Provide each SGL door(s) with the following:

<u>QT</u> <u>Y</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>		<u>FINIS</u> <u>H</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	•	640	IVE
1	EA	PASSAGE SET	T101 DAN	•	613	FAL
1	EA	WALL STOP	WS406/407 (CCV OR CVX AS REQ'D)	•	613	IVE
3	EA	SILENCER	SR64	•	GRY	IVE

Door Index

Door Numbers	HwSet#
100	03
101	01
101A	06
102	02
103	03
104	01
105	06
106	05
108	04
109A	02
109B	02
109C	02

END OF SECTION

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board assemblies.
 - 2. Tile backing panels.
- B. Related Requirements:
 - 1. Section 09 30 13 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Gypsum wallboard.
 - 2. Gypsum ceiling board.
 - 3. Impact-resistant gypsum board.
 - 4. Mold-resistant gypsum board.
 - 5. Cementitious backer units.
 - 6. Interior trim.
 - 7. Aluminum trim.
 - 8. Joint treatment materials.
 - 9. Sound-attenuation blankets (at interior walls only).
 - 10. Acoustical sealant.

1.3 QUALITY ASSURANCE

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 GYPSUM BOARD, GENERAL

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

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. Certainteed; SAINT-GOBAIN.
 - c. Continental Building Products, LLC.
 - d. Georgia-Pacific Gypsum LLC.
 - e. National Gypsum Company.
 - f. USG Corporation.
2. Thickness: 5/8 inch.
3. Long Edges: Tapered .

B. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. Certainteed; SAINT-GOBAIN.
 - c. Continental Building Products, LLC.
 - d. Georgia-Pacific Gypsum LLC.
 - e. National Gypsum Company.
 - f. USG Corporation.
2. Thickness: 1/2 inch.
3. Long Edges: Tapered.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Certainteed; SAINT-GOBAIN.
 - b. James Hardie Building Products, Inc.
 - c. National Gypsum Company.
 - d. USG Corporation.
 - e. Or Approved Equal.
2. Thickness: 5/8 inch .
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc .
 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - d. Base-of-Wall Galvanized Moisture Barrier Trim: Galvanized-steel sheet, 2 inches high.
 - 1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a) VersaDry, LLC.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corporation.
 - b. Gordon, Inc.
 - c. Tamlyn.
 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.
 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified .

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
1. Interior Gypsum Board: Paper.
 2. Exterior Gypsum Soffit Board: Paper.
 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 4. Finish Coat: For third coat, use setting-type, sandable topping drying-type, all-purpose compound.
 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound .
- D. Joint Compound for Tile Backing Panels:
1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
- C. 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.
 - 1. Located only at interior walls/partitions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
 - H. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
 - I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
 2. Ceiling Type: Ceiling surfaces.
 3. Impact-Resistant Type: As indicated on Drawings in Finish Schedule notes .
 4. Mold-Resistant Type: As indicated on Drawings in Finish Schedule notes .
- B. Single-Layer Application:
 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLATION OF TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLATION OF TRIM ACCESSORIES

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

- B. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges .
 - 3. U-Bead: Use where indicated .

3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - 1. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated .
 - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

SECTION 09 30 13 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ceramic wall tile.
 - 2. Coved ceramic base tile
- B. Related Requirements:
 - 1. Section 07 92 00 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 2. Section 09 29 00 "Gypsum Board" for cementitious backer units .

1.2 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Face Size: Actual tile size, excluding spacer lugs.
- C. Module Size: Actual tile size plus joint width indicated.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 10 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 10 percent of amount installed for each type, composition, and color indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile from single source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

2.3 TILE PRODUCTS

- A. Ceramic Wall Tile Type :
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Olean; a brand of Dal-Tile Corporation.
 - b. Daltile; a brand of Dal-Tile Corporation (Basis of Design: Colorwheel Linear).
 - c. Marazzi USA; a brand of Dal-Tile Corporation.
 - d. Seneca Tiles, Inc.
 - e. Or Approved Equal
 - 2. Module Size: 8 x 24 inches (field tile) .
 - 3. Face Size Variation: Rectified.
 - 4. Thickness: 5/16 inch.

5. Face: Plain with modified square edges or cushion edges .
6. Finish: Semi-Gloss
7. Basis of Design Tile Color: Daltile Biscuit.
8. Pattern: See Interior Elevations
9. Basis of Design Grout Color: Mapei Bahamas Beige.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base : Straight, module size 4-1/4 x 12-7/8 inches .
 - b. Wainscot Cap: Surface bullnose, module size 4-1/4 x 12-7/8 inches .
 - c. External Corners: Wall bullnose corner, same size as adjoining flat tile.
 - d. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

2.4 SETTING MATERIALS

- A. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atlas Minerals & Chemicals, Inc.
 - b. Bostik; Arkema.
 - c. H.B. Fuller Construction Products Inc. / TEC.
 - d. Laticrete International, Inc.
 - e. MAPEI Corporation.
 - f. Sakrete; CRH Americas, Oldcastle APG.
 - g. Southern Grouts & Mortars, Inc.
 - h. Or Approved Equal.
 2. Verify adhesives have a VOC content meeting requirements in Section 01 57 19.11 "Interior Air Quality" .
 3. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 4. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

2.5 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

2.6 MISCELLANEOUS MATERIALS

- A. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
 1. Verify products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.7 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION OF CERAMIC TILE

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for

straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in pattern shown on Drawings. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Ceramic Tile: 1/4 inch .
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.5 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. TCNA W244C or TCNA W244F : Thinset mortar on cementitious backer units or fiber-cement backer board.
 - a. Thinset Mortar: Standard dry-set mortar.
 - b. Grout: Standard sanded cement grout.

END OF SECTION 09 30 13

SECTION 09 65 43 - LINOLEUM FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Linoleum sheet flooring.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For layout of linoleum flooring.
 - 1. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 2. Show details of special patterns.
- C. Samples for Selection Confirmation: For linoleum flooring and for rubber base.
 - 1. Samples shall be 2 x 2 inch segments of actual products, not simulated.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of linoleum flooring to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sheet Flooring: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, in roll form and in full roll width for each type, color, and pattern of sheet flooring installed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 65 deg F or more than 90 deg F.
 - 1. Sheet Flooring: Store rolls upright.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring during the following periods:
 - 1. 72 hours before installation.
 - 2. During installation.

3. 72 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F .
- C. Close spaces to traffic during flooring installation.
- D. Close spaces to traffic for 72 hours after flooring installation.
- E. Install flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Verify flooring products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 LINOLEUM SHEET FLOORING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Armstrong World Industries, Inc.
 2. Forbo Flooring Systems (Basis of Design: Marmoleum).
 3. Johnsonite; a Tarkett company.
- B. Linoleum Sheet Flooring: ASTM F 2034, Type I, linoleum sheet with backing .
 1. Roll Size: In manufacturer's standard length, but not less than 78 inches wide.
- C. Thickness: 0.10 inch .
- D. Heat-Welding Bead: For seamless installation, solid-strand product of linoleum flooring manufacturer.
 1. Colors: Match flooring color.
- E. Basis of Design Color: Forbo Silt.

2.3 INSTALLATION MATERIALS

- A. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit products and substrate conditions indicated.
 1. Verify adhesives have a VOC content compliant with Section 01 57 19.11 "Indoor Air Quality" .
 2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 ACCESSORIES

- A. Thermoset Rubber Base

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johnsonite; a Tarkett company.
 - b. Roppe Corporation; Roppe Holding Company
 - c. Or Approved Equal.
2. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
3. Style and Location:
 - a. Style B, Cove: Provide in interior areas with linoleum flooring and sealed concrete flooring. See also Finish Schedule on Drawings.
4. Thickness: 0.125 inch.
5. Height: 6 inches.
6. Lengths: Coils in manufacturer's standard length.
7. Inside Corners: Job formed or preformed
8. Basis of Design Color: Roppe Burnt Umber.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 1. 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 flooring.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to linoleum flooring manufacturer's written instructions to ensure adhesion of flooring.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by linoleum flooring manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by linoleum flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by adhesive manufacturer. .
 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Confirm moisture vapor emissions and internal relative humidity meet the limits stated by the manufacturer of the flooring and adhesive.
 - b. If none given by manufacturer: Concrete moisture vapor emissions must not exceed 8.0 lbs. per 1,000 square feet in 24hours and concrete internal relative humidity must not exceed 85% during installation.

- C. Do not install flooring until materials are the same temperature as space where they are to be installed.
 - 1. At least 72 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by flooring.

3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions for installing flooring.
- B. Scribe and cut flooring to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, thresholds, door frames, and nosings.
- C. Extend flooring into toe spaces, door reveals, closets, and similar openings.
- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- E. Install flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.
- F. Adhere flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- G. Heat-Welded Seams: For seamless installation, comply with ASTM F 1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

3.4 LINOLEUM SHEET FLOORING INSTALLATION

- A. Unroll linoleum sheet flooring and allow it to stabilize before cutting and fitting.
- B. Lay out linoleum sheet flooring as follows:
 - 1. Maintain uniformity of flooring direction.
 - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
 - 3. Match edges of flooring for color shading at seams.
 - 4. Avoid cross seams.
 - 5. Eliminate deformations that result from hanging method used during drying process (stove bar marks).

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting linoleum flooring.

- B. Perform the following operations immediately after completing linoleum flooring installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.

- C. Protect linoleum flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

- D. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover linoleum flooring until Substantial Completion.

END OF SECTION 09 65 43

SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Primers.
 - 2. Finish coatings.
- B. Related Requirements:
 - 1. Section 05 12 00 "Structural Steel Framing" for shop priming of metal substrates.
 - 2. Section 05 50 00 "Metal Fabrications" for shop priming metal fabrications.
 - 3. Section 07 46 46 "Fiber Cement Siding" for shop priming cementitious siding.
 - 4. Section 09 93 00 "Staining and Transparent Finishing" for surface preparation and application of wood stains and transparent finishes on exterior wood substrates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include preparation requirements and application instructions.
 - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Colors to be selected by Contracting Officer from full range of Manufacturer's selection.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 QUALITY ASSURANCE

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Coronado Paint; Benjamin Moore & Co.
 - 3. PPG Paints; PPG Industries, Inc.
 - 4. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
 - 5. Sherwin-Williams Company (The).
 - 6. Valspar; a brand of The Sherwin-Williams Company.
 - 7. Or Approved Equal.
- B. Source Limitations: Obtain each paint product from single source from single manufacturer.

2.2 PAINT PRODUCTS, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.
- B. Basis of Design Color: Benjamin Moore Aura Paint, "Historic Dark Brown."
 - 1. 100 percent of painted surface area will be painted with deep tones.

2.3 PRIMERS

- A. Exterior Wood Preservative: Solvent-based, zinc or copper naphthenate, penetrating antifungal treatment for exterior wood.
- B. Exterior, Latex Wood Primer: White, waterborne-emulsion primer formulated for resistance to extractive bleeding, mold, and microbials; for hiding stains; and for use on exterior wood subject to extractive bleeding.
- C. Water-Based Bonding Primer: Pigmented, water-based-emulsion primer formulated for exterior use and to promote adhesion of subsequent specified coatings.
- D. Water-Based, Rust-Inhibitive Primer: Corrosion-resistant, water-based-emulsion primer formulated for resistance to flash rusting when applied to cleaned, exterior ferrous metals subject to mildly corrosive environments.
- E. Epoxy Metal Primer: Corrosion-resistant, solvent-based, two-component epoxy primer formulated for use on prepared, exterior ferrous- and galvanized-metal surfaces.

2.4 FINISH COATINGS

- A. Exterior 100% Acrylic Latex, Semi-Gloss: Water-based, pigmented, acrylic latex formulated for mold, microbial, and water resistance and for use on exterior, primed, cementitious surfaces.
 - 1. Gloss Level: Manufacturer's standard semi-gloss finish .
 - 2. Fineness of Grind: Manufacturer's standard.
 - 3. Basis of Design: Benjamin Moore Aura Exterior Paint Semi-Gloss.
- B. Exterior, Water-Based, Light Industrial Coating, Semigloss: Corrosion-resistant, water-based, pigmented, emulsion coating formulated for resistance to blocking (sticking of two painted surfaces), water, alkalis, moderate abrasion, and mild chemical exposure and for use on exterior, primed, wood and metal surfaces.
 - 1. Gloss Level: Manufacturer's standard semigloss finish.
- C. Exterior, Water-Based, Light Industrial Coating, Gloss: Corrosion-resistant, water-based, pigmented, emulsion coating formulated for resistance to blocking (sticking of two painted surfaces), water, alkalis, moderate abrasion, and mild chemical exposure and for use on exterior, primed, wood and metal surfaces.
 - 1. Gloss Level: Manufacturer's standard gloss finish.

2.5 FLOOR SEALERS AND PAINTS

- A. Water-Based, Concrete-Floor Sealer: Clear, water-based, acrylic-copolymer-emulsion sealer formulated for oil, gasoline, alkali, and water resistance and for use on exterior, concrete traffic surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Behr Paint Company; Behr Process Corporation.
 - b. H&C Decorative Concrete Products; a brand of Sherwin-Williams Co.
 - c. Hempel (USA), Inc.
 - d. PPG Paints; PPG Industries, Inc.
 - e. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
 - f. Sherwin-Williams Company (The).
 - g. Or Approved Equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Wood: 15 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems specified in this Section.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 3.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Wood Substrates:
 - 1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
 - 2. Sand surfaces that will be exposed to view, and remove sanding dust.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 INSTALLATION

- A. Apply paints in accordance with manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 4. Primers specified in the Exterior Painting Schedule may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 - 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 - 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 - 3. Allow empty paint cans to dry before disposal.
 - 4. Collect waste paint by type and deliver to recycling or collection facility.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

- A. Steel and Iron Substrates (Exposed Structural Steel - base bid; None needed if Option 6 Selected; Misc. Steel - screens at Office Building):
 - 1. Water-Based, Light Industrial Coating over Epoxy System :
 - a. Prime Coat: Epoxy metal primer.
 - b. Intermediate Coat: High-build epoxy paint, low gloss.
 - c. Topcoat: Exterior, water-based, light industrial coating, gloss.
- B. Cementitious Substrate (Factory Primed Fiber Cement Siding)
 - 1. Water-Based, 100% Acrylic Latex Coating System:
 - a. Prime Coat: Shop primer specified in Section 07 46 46 "Fiber Cement Siding."
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, acrylic latex coating, semi-gloss.

END OF SECTION 09 91 13

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Primers.
 - 2. Water-based finish coatings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include preparation requirements and application instructions.
 - 2. Indicate VOC content.
- B. Samples: For each type of topcoat product.

1.4 QUALITY ASSURANCE

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Behr Paint Company; Behr Process Corporation.
 - 2. Benjamin Moore & Co.
 - 3. PPG Paints; PPG Industries, Inc.
 - 4. Sherwin-Williams Company (The).

- B. Source Limitations: Obtain paint product system from single source from single manufacturer.

2.2 PAINT PRODUCTS, GENERAL

- A. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. Material Emissions and Pollutant Control: Verify not less than 85 percent of field-applied paints and coatings that are inside the weatherproofing system comply with one of the following:
 - 1. Low-Emitting Materials: Verify VOC emissions comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify formaldehyde emissions do not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 - 2. Comply with Section 01 57 19.11 "Indoor Air Quality."
- C. Basis of Design Color - Interior Gyp Board: Benjamin Moore Tapestry Beige. Confirm with Contracting Officer through the submittal process.

2.3 PRIMERS

- A. Interior, Institutional Low-Odor/VOC Primer Sealer: Water-based primer sealer with low-odor characteristics and a VOC of less than 10 grams per liter for use on new interior plaster, concrete, and gypsum wallboard surfaces that are subsequently to be painted with latex finish coats.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Behr Paint Company; Behr Process Corporation.
 - b. Benjamin Moore & Co.
 - c. McCormick Paints.
 - d. PPG Paints; PPG Industries, Inc.
 - e. Sherwin-Williams Company (The).

2.4 WATER-BASED FINISH COATS

- A. Interior, Latex, High-Performance Architectural Coating, Eggshell: High-performance architectural latex coating providing a significantly higher level of performance than conventional latex paints in the areas of scrub resistance, burnish resistance, and ease of stain removal.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Behr Paint Company; Behr Process Corporation.
 - b. Benjamin Moore & Co.
 - c. Kelly-Moore Paints.
 - d. PPG Paints; PPG Industries, Inc.
 - e. Sherwin-Williams Company (The).

2. Gloss and Sheen Level: Manufacturer's standard eggshell finish Gloss of 10 to 25 units at 60 degrees and sheen of 10 to 35 units at 85 degrees when tested in accordance with ASTM D523 .

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Wood: 15 percent.
 2. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Wood Substrates:
 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 2. Sand surfaces that will be exposed to view, and dust off.
 3. Prime edges, ends, faces, undersides, and backsides of wood.
 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.
 1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in occupied spaces:
 - a. No unfinished electrical, mechanical, or security scope is anticipated to be exposed. If during construction this condition becomes necessary, discuss finishes with Contracting officer and proceed as directed by Contracting Officer.
 - b. .

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 3. Allow empty paint cans to dry before disposal.
 4. Collect waste paint by type and deliver to recycling or collection facility.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. Gypsum Board Substrates:
1. High-Performance Architectural Latex System :

- a. Prime Coat: Interior latex primer sealer.
- b. Intermediate Coat: Matching topcoat.
- c. Topcoat: Interior, latex, high-performance architectural coating, eggshell .

END OF SECTION 09 91 23

SECTION 09 93 00 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and application of wood finishes at the Monument Sign and Variable Message Sign.
- A. Section includes surface preparation and application of wood finishes at the Monument Sign and Variable Message Sign.
- B. Related Sections include the following:
 - 1. Section 06 10 63 – Exterior Rough Carpentry

1.2 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- D. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of finish system and in each color and gloss of finish indicated.
 - 1. Submit Samples on representative samples of actual wood substrates, inches (200 mm) long.
 - 2. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules.

2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the product proposed for use highlighted.
3. VOC content.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Contracting Officer will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
 2. Final approval of stain color selections will be based on mockups.
 - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply finishes when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Benjamin Moore & Co.

2.2 MATERIALS, GENERAL

- A. Material Compatibility:

1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.
- B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.
1. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
 2. Shellacs, Clear: VOC not more than 730 g/L.
 3. Stains: VOC not more than 250 g/L.
 4. Primers, Sealers, and Undercoaters: 200 g/L.
- C. Low-Emitting Materials: Interior stains and finishes shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 STAINS

- A. Stain, Exterior, Water Based, Solid Hide
1. Location: Monument Sign : HDU foam board panels, wood logs and posts, Variable Message Sign and Camera Wood Post
 2. Product: ArborCoat Waterborne Exterior Solid Stain
 3. Color: Embassy Green
 - a. Base 2, 640 2X
 - b. Y3 2X 26.0000
 - c. S1 1X 8.0000
 - d. W1 3X 8.0000
 - e. R1 1X 0.0000

2.4 SOLVENT-BASED VARNISHES

- A. Varnish, with UV Inhibitor, Exterior, Semi-Gloss (Gloss Level 5)
1. Location: Monument Sign Lettering
 2. Product: Super Spec D.T.M. Alkyd Semi-Gloss or approved equal.
 3. Color: Chrome Green
 - a. Ultra Base , P24-4B
 - b. YW 1X 8.00
 - c. BK 2X 10.00
 - d. TG 8X 24.00
 - e. WH 0X 26.00

2.5 SOURCE QUALITY CONTROL

- A. Testing of Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample wood finishing materials. Contractor will be notified in advance and may be present when samples are taken. If materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying wood finishes if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and refinish surfaces finished with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces before refinishing with complying materials if the two finishes are incompatible or produce results that, in the opinion of the Architect, are aesthetically unacceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with finish application only after unsatisfactory conditions have been corrected.
1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations.
- B. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.
1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

C. Exterior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Prime edges, ends, faces, undersides, and backsides of wood.
 - a. For solid hide stained wood, stain edges and ends after priming.
 - b. For varnish coated stained wood, stain edges and ends and prime with varnish. Prime undersides and backsides with varnish.

3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions and recommendations.
1. Use applicators and techniques suited for finish and substrate indicated.
 2. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

1. Solid Hide, Water-Based Stain System:
 - a. Prime Coat: Primer, alkyd for exterior wood.
 - b. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
 - c. Topcoat: Stain, exterior, water based, solid hide.

END OF SECTION 09 93 00

SECTION 09 96 00 – HIGH PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and field painting of the following:
 - 1. Exposed steel bollards.
 - 2. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Related Section:
 - 1. Section 09 91 13 - Exterior Painting

1.2 DEFINITIONS

- A. General: The standard procedure for measuring specular gloss is contained in ASTM D 523.
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 - 2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
 - 3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
 - 4. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
 - 5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.3 SUBMITTALS

- A. Product Data: For each paint system specified. Include block fillers and primers.
 - 1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
 - 3. Submit manufacturer's data for paint system and manufacturer proposed by the Contractor to paint existing interior columns and mechanical enclosures for CO's review.
- B. Samples for Selection: Provide manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.
 - 1. After color selection, Contractor shall furnish color chips for surfaces to be coated for approval.

- C. Samples for Verification: Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
 - 1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 - 2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.
 - 3. Submit Samples on the following substrates for the CO's review of color and texture only:
 - a. Metal: Provide two 4-inch- (100-mm-) square samples of finish of metal and two 8-inch- (200-mm-) long samples of solid metal for each color and finish.
- D. Qualification Data: For firms and persons specified in the "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.

1.4 QUALITY ASSURANCE

- A. Pre-construction meeting for paint required prior to beginning work in the Lobbies, and refinishing the column covers and mechanical enclosures located in level one of Lobby.
- B. Applicator Qualifications: Engage an experienced applicator that has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.
- C. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.
- D. Field Quality Control:
 - 1. Provide mock-up of paint colors on-site, covering 60 SF for review and approval of color and sheen.
 - 2. Review of first finished room, space, or item of each color scheme is required by CO for color, texture, and workmanship.
 - 3. Use first acceptable room, space or item as Project standard for each color scheme.
 - 4. For spray application, paint surface not smaller than 100 square feet as Project standard.
- E. Secondary products not specified by name and required for the job such as shellac shall be "best grade" or "first line" products.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.

6. Application instructions.
 7. Color name and number.
 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.6 PROJECT CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F (10 and 32 deg C).
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg F (7.2 and 35 deg C).
- C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Provide one of the products in the paint schedules.
- B. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
1. Tnemec Company, Inc. (Tnemec).
- C. Materials selected for coating systems for each type of surface shall be the product of a single manufacturer.

2.2 MATERIALS

- A. Quality: Provide the best quality grade of the various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Paint material containers not displaying manufacturer's product identification will not be acceptable.
- B. No claim as to the unsuitability or unavailability of any material specified, or unwillingness to use specified products, or inability to produce first-class work with specified products, will be entertained.
- C. Material Compatibility: Provide block fillers, primers, finish coat materials, and related materials

that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.

D. Material Quality: Provide the manufacturer's best-quality trade sales paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

E. Colors:

1. Provide color selections made by the CO from the manufacturer's full range of standard colors.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.

1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the CO about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and re-prime.
2. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

3. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
 4. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
 5. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
 6. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 7. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
 8. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 2. Provide finish coats that are compatible with primers used.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer on metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special

attention to ensure edges, corners, crevices, and welds, receive a dry film thickness equivalent to that of flat surfaces.

4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- E. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- F. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- G. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
1. Provide satin finish for final coats unless indicated otherwise.
- H. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- I. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.5 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by CO.
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
 - 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 PAINTING SCHEDULE

- A. The following schedule for finishing is not intended to mention every particular item that will receive painter's finish. The kinds of paint and number of coats required on the various surfaces shall be as scheduled.
- B. Paint Color: As selected by CO.

3.7 EXTERIOR PAINT SYSTEMS

- A. Ferrous Metal: Shop primer must be compatible with paint systems specified below:
 - 1. Paint System -: Two finish coats over primer.
 - a. Primer: Synthetic rust-inhibiting primer.
 - 1) Tnemec: Alkyd Metal Primer or approved equal.
First and Second Coats: Acrylic Latex.
 - 2) Tnemec metallic; submit product or approved equal.

END OF SECTION 09 96 00

SECTION 10 14 23.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes interior room-identification signs that are directly attached to the building.

1.3 ALLOWANCES

- A. Code required room identification signs (provision and installation) are part of Signage Allowance .

1.4 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard (ABAAS).

1.5 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements , including raised characters and Braille, and layout for each sign at least half size .
- C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Room-Identification Signs: Full-size Sample .
 - 2. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
 - 3. Full-size Samples, if approved, will be returned to Contractor for use in Project.
- D. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the ABA standards of the Federal agency having jurisdiction and ICC A117.1 .

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign : Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Graphics, Inc.
 - b. ASE, Inc.
 - c. ASI Sign Systems, Inc.
 - d. Best Sign Systems, Inc.
 - e. Clarke Systems.
 - f. Diskey Sign Company.
 - g. Foresight Supersign.
 - h. inpro Corporation.
 - i. Mohawk Sign Systems.
 - j. Poblocki Sign Company, LLC.
 - k. Signs & Decal Corp.
 - l. Vista System, LLC.
 - m. Vomar Products, Inc.
 - 2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign .
 - b. Surface-Applied Graphics: Applied paint .
 - c. Color(s): As selected by Contracting Officer from manufacturer's full range .
 - 3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition : Square cut .
 - b. Corner Condition in Elevation: Square .
 - 4. Frame: Entire perimeter .
 - a. Material: Aluminum, Frameless also acceptable.
 - b. Profile: Square .
 - c. Corner Condition in Elevation: Square .
 - d. Finish and Color: As selected by Contracting Officer from manufacturer's full range .
 - 5. Mounting: Manufacturer's standard method for substrates indicated with adhesive or two-face tape .
 - 6. Text and Typeface: Accessible raised characters and Braille typeface as selected by Contracting Officer from manufacturer's full range . Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 SIGN MATERIALS

- A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- B. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings.
- C. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

- A. Adhesive: As recommended by sign manufacturer.
 - 1. Verify adhesives have a VOC content compliant with Section 01 57 19.11 Indoor Air Quality.
- B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls and according to the accessibility standard .
- C. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - 2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
 - 3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
 - 4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
 - 5. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips 0.250 inch away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.
 - 6. Magnetic Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.

- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Contracting Officer..

END OF SECTION 10 14 23.16

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Wall guards / Abuse Resistant Wall Covering .
 - 2. Abuse-resistant wall coverings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
 - 2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
 - 1. Include plans, elevation (size verified in field) and attachment details.
- C. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.
 - 1. Include Samples of accent strips and accessories to verify color selection.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
 - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
 - 2. Keep plastic materials out of direct sunlight.

3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
 - a. Store corner-guard covers in a vertical position.
 - b. Store wall-guard covers in a horizontal position.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
 - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 .

2.2 WALL GUARD / ABUSE-RESISTANT WALL COVERINGS

- A. Abuse-Resistant Sheet Wall Covering (E28) : Fabricated from semirigid, plastic sheet wall-covering material.
 1. Size: As shown on drawings. Verify in field prior to cutting to size .
 2. Sheet Thickness: 0.125 inch .
 3. Color and Texture: As selected by Contracting Officer from manufacturer's full range .
 4. Height: As shown on drawings .
 5. Trim and Joint Moldings: Extruded rigid plastic that matches wall-covering color.
 6. Mounting: Adhesive.

2.3 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Polycarbonate Plastic Sheet: ASTM D 6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. of notch when tested according to ASTM D 256, Test Method A.

- C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- D. Adhesive: As recommended by protection product manufacturer.
 - 1. Verify adhesives have a VOC content complying with Section 01 57 19.11 Indoor Air Quality.

2.4 FABRICATION

- A. Fabricate wall protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.5 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
 - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
 - 2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
 - 3. Adjust end and top caps as required to ensure tight seams.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 26 00

SECTION 10 28 00 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Staff-use washroom accessories.
 - 2. Underlavatory guards.
- B. Related Requirements:
 - 1. Section 09 30 13 "Ceramic Tiling" for ceramic toilet and bath accessories.

1.2 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 STAFF-USE WASHROOM ACCESSORIES

- A. Toilet Tissue (Roll) Dispenser (A) :
 - 1. Basis of Design: Bobrick B-4288 (or equal)
 - 2. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset .
 - 3. Mounting: Surface mounted.
 - 4. Operation: Noncontrol delivery with standard spindle; Unit holds two standard core tissue rolls, which are loaded and locked into dispensing mechanism; Extra roll drops into place when bottom roll is depleted. .
 - 5. Capacity: Designed for 5-inch- diameter tissue rolls.
 - 6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin) Chrome-plated zinc alloy (zamac) or steel .

- B. Paper Towel (Folded) Dispenser (H):
1. Basis of Design: Bobrick B-4262 (or equal)
 2. Mounting: Surface mounted.
 3. Minimum Capacity: 400 C-fold or 525 multifold towels .
 4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin) .
 5. Lockset: Tumbler type.
 6. Refill Indicator: Pierced slots at sides or front.
- C. Automatic Soap Dispenser (F) :
1. Basis of Design: GOJO LTX-12 Dispenser (or equal)
 2. Description: Automatic dispenser with infrared sensor to detect presence of hands; battery powered; designed for dispensing soap in lather form.
 3. Mounting: Surface mounted.
 4. Capacity: 1200 mL.
 5. Materials: Plastic; Color to be selected by Contracting Officer from manufacturer's standard range.
 6. Refill Indicator: LED indicator.
 7. Low-Battery Indicator: LED indicator.
- D. Grab Bar (D.1 and D.2) :
1. Basis of Design: Bobrick B-5806 (or equal)
 2. Mounting: Flanges with concealed fasteners.
 3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin).
 4. Outside Diameter: 1-1/4 inches .
 5. Configuration and Length: As indicated on Drawings .
- E. Mirror Unit (E13) :
1. Basis of Design: Bradley 780 (or equal)
 2. Frame: Stainless steel angle, 0.05 inch thick .
 - a. Corners: Welded and ground smooth.
 3. Size: As indicated on Drawings .
 4. Hangers: Manufacturer's standar .
- F. Hook (E39) :
1. Basis of Design: Bobrick B-211 (or equal)
 2. Description: Single-prong unit .
 3. Mounting: Concealed .
 4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin) or brass cast with satin nickel-plated finish.

2.3 UNDERLAVATORY GUARDS

- A. Underlavatory Guard :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Plumberex Specialty Products, Inc.
 - b. Truebro; IPS Corporation.
 2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.

3. Material and Finish: Antimicrobial, molded plastic, white.

2.4 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.5 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 10 28 00

SECTION 10 44 13 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire-protection cabinets for the following:
 - a. Portable fire extinguisher.
- B. Related Requirements:
 - 1. Section 10 44 16 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets
 - 2. Section 21 12 00 "Fire-Suppression Standpipes" for fire-hose connections.

1.2 PREINSTALLATION CONFERENCE

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing semirecessed-mounting method and relationships of box and trim to surrounding construction.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

2.3 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher .
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis.
 - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.

- c. Larsen's Manufacturing Company.
 - d. Modern Metal Products.
 - e. MOON American, Inc.
 - f. Nystrom, Inc.
 - g. Potter Roemer LLC; a Division of Morris Group International.
 - h. Strike First Corporation of America.
 - i. Or Approved Equal.
- B. Cabinet Construction: Nonrated .
- C. Cabinet Material: Cold-rolled steel sheet or Aluminum sheet .
- 1. Shelf: Same metal and finish as cabinet.
- D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
- 1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.
 - 2. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- E. Cabinet Trim Material: Steel sheet or Aluminum sheet .
- F. Door Material: Steel sheet, or Aluminum sheet .
- G. Door Style: Fully glazed panel with frame or Center glass panel with frame .
- H. Door Glazing: Tempered break glass .
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- 1. Provide manufacturer's standard.
 - 2. Provide continuous hinge, of same material and finish as trim, , permitting door to open 180 degrees.
- J. Accessories:
- 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Contracting Officer .
 - a. Identify fire extinguisher in fire-protection cabinet with the words " FIRE EXTINGUISHER ."
 - 1) Location: Applied to cabinet door or cabinet glazing .
 - 2) Lettering Color: As selected by Contracting Officer from Manufacturer's standard range.
 - 3) Orientation: As selected by Contracting Officer from Manufacturer's standard options.
- K. Materials:
- 1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.

- b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Color: As selected by Contracting Officer from manufacturer's full range .
- 2. Aluminum: ASTM B221 for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet.
 - a. Finish: Baked enamel or powder coat.
 - b. Color: As selected by Contracting Officer from full range of industry colors and color densities .
- 3. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, .
- 4. Tempered Break Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Miter corners and grind smooth.
 - 3. Provide factory-drilled mounting holes.
 - 4. Prepare doors and frames to receive locks.
 - 5. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 - 2. Fabricate door frames of one-piece construction with edges flanged.
 - 3. Miter and weld perimeter door frames and grind smooth.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at height indicated below:
 - 1. Fire-Protection Cabinet Mounting Height: 42 inches above finished floor to top of fire extinguisher.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
 - 2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification:
 - 1. Apply decals or vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 13

SECTION 10 51 13 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Knocked-down corridor lockers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.
- B. Shop Drawings: For metal lockers.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Show locker trim and accessories.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain metal lockers and accessories from single source from single locker manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the ABA standards of the Federal agency having jurisdiction and ICC A117.1 .

2.3 KNOCKED-DOWN CORRIDOR LOCKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AJW Architectural Products.
 - 2. Art Metal Products.
 - 3. ASI Storage Solutions.
 - 4. Hadrian Inc.; Zurn Industries, LLC.
 - 5. List Industries Inc.
 - 6. LockersMFG.
 - 7. Lyon LLC.
 - 8. Olympus Lockers & Storage Products, Inc.
 - 9. Penco Products, Inc.
 - 10. Republic Storage Systems, LLC.
 - 11. Salsbury Industries.
 - 12. WEC Manufacturing LLC.
- B. Doors: One piece; fabricated from 16 ga. minimum steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
 - 1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
 - 2. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch nominal-thickness steel sheet; welded to inner face of doors.
 - 3. Sound-Dampening Panels: Manufacturer's standard, designed to stiffen doors and reduce sound levels when doors are closed, of die-formed metal with full perimeter flange and sound-dampening material; welded to inner face of doors.
 - 4. Door Style: Vented panel as follows:

- a. Concealed Vents: Slotted perforations in top and bottom horizontal door return flanges.
- C. Body: Assembled by riveting or bolting body components together. Fabricate from 16 ga. minimum unperforated steel sheet.
- D. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.
 - 1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
 - 2. Frame Vents: Fabricate face frames with vents.
- E. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
 - 1. Hinges: Manufacturer's standard, steel, continuous or knuckle type.
- F. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
 - 1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.
 - a. Latch Hooks: Equip doors 48 inches and higher with three latch hooks and doors less than 48 inches high with two latch hooks; fabricated from 0.105-inch nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
- G. Hooks: Manufacturer's standard ball-pointed hooks, aluminum or steel; zinc plated.
- H. Legs: 6 inches high; formed by extending vertical frame members, or fabricated from 0.075-inch nominal-thickness steel sheet; welded to bottom of locker.
 - 1. Closed Front and End Bases: Fabricated from 0.036-inch nominal-thickness steel sheet.
- I. Continuous Sloping Tops: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch nominal-thickness steel sheet.
 - 1. Sloping-top corner fillers, mitered.
- J. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
- K. Materials:
 - 1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 - 2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with A60 zinc-iron, alloy (galvannealed) coating designation.

3. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 10 percent.

- L. Finish: Baked enamel or powder coat.
 1. Color: As selected by Contracting Officer from manufacturer's full range .

2.4 FABRICATION

- A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.
- C. Equipment: Provide each locker with an identification plate and the following equipment:
 1. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
- D. Knocked-Down Construction: Fabricate metal lockers by assembling at Project site , using manufacturer's nuts, bolts, screws, or rivets.
- E. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.
- F. Accessible Lockers: Fabricate as follows:
 1. Locate bottom shelf no lower than 15 inches above the floor.
 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.
- G. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
 1. Sloping-top corner fillers, mitered.
- H. Recess Trim: Fabricated with minimum 2-1/2-inch face width and in lengths as long as practical; finished to match lockers.
- I. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.
- J. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
 1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.5 ACCESSORIES

- A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- B. Anchors: Material, type, and size required for secure anchorage to each substrate.
 - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls for corrosion resistance.
 - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lockers level, plumb, and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 - 2. Anchor single rows of metal lockers to walls near top .
 - 3. Anchor back-to-back metal lockers to floor.
- B. Knocked-Down Lockers: Assemble with manufacturer's standard fasteners, with no exposed fasteners on door faces or face frames.
- C. Equipment:
 - 1. Attach hooks with at least two fasteners.
 - 2. Attach door locks on doors using security-type fasteners.
 - 3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
 - b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.
- D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach recess trim to recessed metal lockers with concealed clips.
 - 2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
 - 3. Attach sloping-top units to metal lockers, with closures at exposed ends.
 - 4. Attach boxed end panels using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.

5. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

3.3 ADJUSTING

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

3.4 PROTECTION

- A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 51 13

SECTION 10 81 19 – RODENT CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work of this section consists of furnishing, installing, and maintaining barriers to protect existing facilities from rodent entry or intrusions.
- B. Items to be Protected from Rodent Entry: Including, but not limited to exterior electrical outlet and other utility covers, ceiling battens and trim, base trim, window and door trim, historic wall floor and fireplace finishes and materials, light fixtures, and other materials as indicated.
- C. Neoprene seals, spray-in-place foam, and similar products commonly used to close openings are not rodentproof. Even in new buildings, utility pipes, electrical conduit (often at meters or circuit breaker panels), water and gas lines, and communication cables may have large openings that permit entry of mice and rats. Once rodents have entered walls, they generally have ready access to much of a building via holes for utility pipes and wires in the framing, via overhead suspended ceilings, beneath raised floor or other types of construction adjacent to utility enclosures.
- D. Specific problem areas include poorly sealed heating and air conditioning ducts; roof and wall vents installed without strong, well-attached hardware cloth screening; roof and wall joints and edges without properly installed metal flashing; and doors hung unevenly or too high, or lined with unprotected soft rubber weather stripping.
- E. Refuse and food handling areas are likely to have the greatest rodent pressure. In historic buildings, cracks in concrete slabs, plaster, brick and concrete block walls, or worn or damaged drain covers allow rodent entry. Air ventilation shafts and fireplace chimney also require inspection and installation of barriers and controls.
- F. Contractor shall maintain a clean and debris-free site. If the area is known to have heavy rat and/or mouse problems, contractor shall use exterior surface materials that have a hard, smooth surface on at least the lower levels that will be subject to contact with the ground, ornamental plantings, fences, and other potential areas of rodent harborage.
- G. Contractor shall tightly rodent-proof sewer, electrical, communication, water, and natural gas services, as well as exterior doors and windows. Doors should have automatic door-closing devices, and construction materials that preclude rodent climbing and entry.
- H. During construction, the contractor shall implement measures to keep the job site free of rubbish, foodstuff and other items as necessary to avoid attracting rodents and shall also trap/bait for rodents as necessary to control rodent intrusion.

1.2 CONTRACTOR'S USE OF THE PREMISES

- A. The buildings will be closed to the public during construction.

- B. Contractor shall at all times conduct their operations to ensure the least inconvenience to the National Park Service who will be conducting regular activities at the temporary kiosk throughout the construction period. All activities in and around the buildings shall be coordinated with the Park officials through the Contracting Officer.
- C. Preservation of Natural Features: Confine all operations to work limits of the project. Prevent damage to natural surroundings. Restore damaged areas, repairing or replacing damaged trees and plants, at no additional expense to the Government.
 - 1. Provide temporary barriers to protect existing trees and plants and root zones.
 - 2. Do not remove, injure, or destroy trees or other plants without prior approval. Consult with Contracting Officer and remove agreed on roots and branches that interfere with construction.
 - 3. Do not fasten ropes, cables, or guys to existing trees.
- D. Hauling Restrictions: Comply with all legal load restrictions in the hauling of materials. Load restrictions on park roads are identical to the state load restrictions with such additional regulations as may be imposed by the Park Superintendent. Information regarding rules and regulations for vehicular traffic on park roads may be obtained from the Office of the Park Superintendent. A special permit will not relieve Contractor of liability for damage which may result from moving of equipment.

1.3 SPECIAL CONSTRUCTION REQUIREMENTS

- A. Special Historic Preservation Requirements: The buildings and road construction in this project are new, but the area is historic. There are requirements for monitoring for work performed below grade in specific areas. The rodent control scope is not anticipated to impact historic areas, but the contractor is required to be aware of the requirements related to protecting the historic resources.

1.4 FIELD VERIFICATION AND QUALITY ASSURANCE

- A. Field verify all new and existing dimensions affecting the work of this contract before ordering products.
- B. At project closeout, rodent exclusion specialist shall provide a field report, including photographs of rodent exclusion measures, confirming that these measures have been consistently applied throughout the project's scope of work.
 - 1. Field report shall be reviewed and approved by the Contracting Officer.

1.5 CONSTRUCTION MATERIALS

- A. The Government will not furnish any materials for this project.

1.6 REFERENCE DOCUMENTATION

- A. All work shall also comply with:

1. National Park Service, *Rodent Exclusion Manual*, Published by the US Department of the Interior, National Park Service, Natural Resource Stewardship and Science: Fort Collins, CO, September 2014.

PART 2 - PRODUCTS

2.1 PERSONAL PROTECTIVE EQUIPMENT - DURING DEMOLITION

A. Respiratory Protection:

1. Workers who abate asbestos or create dusts from LCP shall be provided with personally issued, individually identified respirators that meet the required level of protection. During pre-cleaning, installation of critical barriers, and HEPA vacuuming activities, the Contractor shall utilize (at a minimum) half face air-purifying respirators with approved HEPA filter cartridges. At a minimum, the Contractor shall utilize Powered Air Purifying Respirators (PAPR) for removal and cleanup work. Respiratory cartridges will be, at a minimum, N-100 or P-100 filters.
2. The Contractor shall provide workers with and require the use of respirators approved by NIOSH for asbestos in accordance with OSHA Standard 29 CFR 1926.1101 and IOSHA Title 620 Article 1 IAC. The minimum respiratory protection allowable shall be an approved half-mask air-purifying respirator with HEPA cartridges. Half-mask respirators will be used during pre-cleaning only. A full-face piece will be required at all other times. Disposable single-use respirators will not be permitted. The initial respiratory protection provided shall be chosen prior to commencement of removal operation based on data from past exposure assessment monitoring or initial monitoring performed to accurately determine the airborne concentration of asbestos to which employees may be exposed.
3. Workers must perform positive and negative air pressure fit tests each time a respirator is put on, whenever the respirator design so permits. Powered air-purifying respirators shall be tested for adequate flow as specified by the manufacturer.
4. Workers shall be given a qualitative fit test in accordance with procedures detailed in OSHA 29 CFR 1926.1101 and IOSHA Title 620 Article 1 IAC for all respirators to be used. An appropriately administered quantitative fit test may be substituted for the qualitative fit test. Documentation of adequate respirator fit must be provided to the Contractor. Fit tests shall be administered annually.

B. Personal Protection required for Rodent Removal/Rodent Contaminated Material Handling:

1. Prior to commencement of cleaning of rodent infested areas, all personnel who will be required to enter the work area for handling of rodent infested and contaminated materials will have hazard awareness training. Special on-site training on equipment and procedures unique to this job site shall be performed as required. Training in emergency response and evacuation procedures shall also be provided.
2. All respiratory protection shall be provided to workers through a written respiratory protection program. This program shall be available on the jobsite.
3. Disposable clothing including head, foot and full body protection shall be provided in sufficient quantities and adequate sizes for all workers and authorized visitors. All personnel engaged in rodent removal work shall wear approved disposable protective clothing constructed of spun-bonded olefin or polypropylene fabrics, or other material of equivalent resistance to penetration. A full body suit is recommended in lieu of a separate set of coveralls, head covers, and shoe covers. Disposable whole-body clothing including head covers, gloves, and shoe coverings shall be provided to and worn by all personnel in

the asbestos control area. If elastic sleeve closures are not provided, sleeves shall be secured with duct tape to gloves. Washable footwear having a non-skid tracking surface shall be provided and used by all personnel within the asbestos control area.

4. Persons having facial hair which may interfere with the seal of a respirator shall not be allowed to enter the work area.
5. The Contractor shall, at all times, have available for use by the Industrial Hygienist, two clean sets of personal protective equipment and clothing (excluding air-purifying negative-pressure respirators, which will be provided by individual visitors), as required for entry in asbestos work areas by these specifications.
6. Respirators shall be worn at all times if rodent contaminated materials are impacted to the extent that airborne emissions are created.
7. Protective eye wear, gloves, rubber boots and/or other footwear shall be provided as required for workers and authorized visitors. Safety shoes may be required for some activities.
8. Eating, drinking, smoking, and chewing gum or tobacco will not be allowed in the work area.

2.2 EQUIPMENT

- A. Material may be new or used, but shall be suitable for intended purpose. Rodent exclusion barriers shall be structurally adequate, neat in appearance and consistent with historical preservation or the historic fabric on or within the structure.

2.3 SCREENS AND BARRIERS

- A. Use only metal window screening materials where windows or doors are accessible to rodents. Avoid unnecessary ledges outside windows. When necessary, screen ventilation openings and windows with woven/welded galvanized hardware cloth. Such screening is critical in buildings and where high rodent pressures are found. For large openings or where the screen may be subject to abuse, add crossbars to support the hardware cloth. If the opening is an access route, install the screen on a hinged frame.
- B. All vents and duct openings for heating and air conditioning should be screened or raised and/or guarded with an excluder device to prevent rodent entry. Cold air return grills, if applicable can easily be mouse-proofed by placing 1/4-inch (0.6-cm) hardware cloth behind the grill where it is not unsightly.
- C. In some applications, power vents can be covered with hinged metal plates (louvered) that open with air flow and close when fans are off. These louvers are only effective if they fit tightly and the sides are recessed to prevent rodents from pushing through them. Caution: Hardware cloth less than 1/2 x 1/2 inch (1.3 x 1.3 cm) significantly reduces air flow. In buildings where ventilation is already marginally adequate or inadequate, such further restrictions may be unacceptable. In some locations, small mesh screens can become clogged with dust or freeze over. In such situations, the use of 1/2 x 1/2-inch (1.3 x 1.3-cm) hardware cloth is a reasonable compromise between ventilation requirements and rodent control.
- D. Exterior Doors. Doors should fit tightly, the distance between the bottom of the door and the threshold not exceeding 1/4 inch (0.6 cm). In some instances, may be required to build up the

threshold rather than modify the door as long as a 1/2" maximum rise is not exceeded for ABAAS compliance..

- E. Fasten metal thresholds to floors. Install flashing or a metal channel on the lower edge of doors, particularly softwood doors; a plastic door boot has been successfully used where the door receives low use and the edges are not easily accessible to rodent gnawing. Properly applied flashing extends to within 1/8 inch (0.3 cm) of the edge of the door at the sides and bottom.
- F. Rodents can claw and gnaw at concrete and Portland cement until it is fully cured, so the use of 1/2-inch (1.3- cm) hardware cloth laid in the top 1/4 inch (0.6 cm) of the repair area may be necessary if rats are currently using the repair area as an entry point. Otherwise, provide an effective temporary rodent-proof protective overlay until the concrete is fully cured. Caution: Metal products placed within 1 inch (2.5 cm) of a concrete or plaster surface will oxidize and may corrode and discolor the plaster or concrete during curing and dwell times.
- G. Another backing material available is Strong Patch™ (D. P. Wagner Mfg. Inc.), a 6 x 6-inch (15 x 15-cm) sheet metal patch to cover holes up to 5 x 5 inches (11 x 11 cm). It has a self-adhesive backing and a mesh on the surface for better adhesion of the patching compound or other texture.

2.4 DISINFECTING SOLUTIONS

- A. Two types of disinfecting solutions are recommended for the clean-up of rodent contaminated materials:
 - 1. General-Purpose Household Disinfectant: Prepare according to the label, if not prediluted. Almost any agent commercially available in the United States is sufficient as long as the label states that it is a disinfectant. Effective agents include those based on phenols, quaternary ammonium compounds, and hypochlorite.
 - 2. Hypochlorite Solution: A chlorine solution, freshly prepared by mixing 1½ cups of household bleach in 1 gallon of water (or a 1:10 solution) can be used in place of a commercial disinfectant. When using chlorine solution, avoid spilling the mixture on clothing or other items that might be damaged by bleach. Wear rubber, latex, vinyl, or nitrile gloves when preparing and using chlorine solutions. Chlorine solutions should be prepared fresh daily.

PART 3 - EXECUTION

3.1 PROTECTION OF STRUCTURES

(Not anticipated for demolition but may be needed if rodents move into buildings as they are being constructed.)

- A. Rodents seek shelter behind, under, or in appliances, sinks cabinets, drawers, stored goods, wall voids, false ceilings, and other undisturbed areas.
- B. Rodents can climb the outside of vertical pipes and conduits up to 3 inches (7.6 cm) in diameter; and climb the outside of larger pipes attached to buildings by bracing themselves between the wall and the pipe.

- C. Rodents can also climb the inside of vertical pipes, wall voids, or structural/expansion seams and joints between 1 1/2 and 4 inches (3.8 and 10.2 cm) in diameter. All installations shall include systems that prevent these intrusions.
- D. Junctures where utilities (pipes, cables) enter structures require special consideration in preventing rodent entry.
- E. Exclusion must include no exterior openings higher or wider than 1/4 inch.
- F. Contractor shall conduct a thorough inspection throughout the structure for potential rodent entry points, look for and document rub marks, droppings, tracks, gnawing, or other rodent signs. Contractor shall install the following, as applicable, at common rodent entry points:
 - 1. Plumbing Vents – Verify that animals seeking shelter have not become stuck in plumbing pipes and then install barriers/screens.
 - 2. Roof & Fascia Spaces – Seal poorly sealed points between roof & fascia that invite animal entry.
 - 3. Roof Vents – Lightweight, flimsy vents shall be replaced with heavy secure roof vents.
 - 4. Roof/Soffit Intersection – Contractor shall secure gaps to prevent animal chewing and entry.
- G. By gnawing, rats can gain entry through any opening greater than 1/2 inch (1.3 cm) across, and mice through any opening larger than 1/4 inch (0.6 cm). The paired front (incisor) teeth of rats and mice curve slightly inward. This inward curve makes it difficult for them to gnaw into a flat, hard surface. When given a rough surface or an edge to bite into, however, they can quickly gnaw into most materials. To prevent rodent entry, seal all such holes with durable materials. Steel wool, copper gauze (Stuf-it® brand) or screen wire packed tightly into openings are temporary plugs that may be used during construction.
- H. For long-term or permanent repair, mix a quick-drying patching plaster or anchoring such as Fixall® into a wad of Stuf-it® before pushing the material into the hole, and smooth over the outside. If steel wool is used, rust stains are likely to result.
- I. Holes 3 inches (8 cm) or more in diameter shall be covered or backed with 1/4-inch (0.6-cm) woven/welded hardware cloth prior to filling with a good patching compound. To close larger openings or protect other areas subject to gnawing, use materials such as those listed in Table 1. Hardware cloth, if not woven, breaks easily. The woven/welded hardware cloth maintains its shape when cut to fit around pipes or other objects. Hardware cloth used to cover gaps and holes can be filled with foam caulk, Fix-all®, Quick-Fix®, or other fast-drying interior patching compounds. When used on the exterior, concrete mortar, plaster, or Concrete Patch® can be used to provide longer term rodent-proofing.
- J. Close openings around pipes, and electric cables where they enter structures with Portland cement mortar, Concrete Patch®, masonry, or metal collars.
- K. All equipment such as refrigerators, freezers, counters, dishwashers, and sanitizers shall be raised and if possible easily movable, enabling cleaning underneath and behind them. Insulated walls and closed areas should be tightly closed off to avoid use as harborage.
- L. Drains shall be cleaned and contractor shall install rodent-proof covers

- M. Optional items for rodent exclusion that conflict with the historic preservation standards and which will require Contracting Officer approval prior to implementation include:
1. To prevent rodents from climbing or traveling along a particular route, install guards made of sheet metal or similar materials. Guards must be wide enough and positioned to keep rodents from reaching their outer margins by climbing or jumping.
 2. Circular guards must extend out 18 inches (46 cm) around the line they guard. They are constructed of 24-gauge metal and anchored in place by one or more arms on the side opposite to that accessible to rats. Cone-shaped circular guards prevent rats from climbing vertical pipes, pilings, and trees. Shields or wire guards made of 1/4-inch (0.6-cm) wire mesh may be used to exclude rodents from the interior of underground power and communications and similar openings.
 3. Gaps or flaws along building exteriors where the wall framing or siding meets the foundation provide easy entry for rodents. Such openings shall be prevented by well-formed and finished concrete work and installation of tight wall framing and siding, or installing metal screed-type flashing between the siding and the foundation. Use of rodent-proof exterior surface materials such as concrete, plaster, or metal sheeting is also effective if properly installed so that all ribs or corrugations are closed. Rodents can enter buildings with piers or shallow foundation walls by burrowing beneath the floor or foundation. To prevent rat entry by this route, where possible extend foundation walls below ground at least 36 inches (91 cm).
 4. Maintain a clean, 3-foot-wide (1-m) weed-free area around building foundations, concrete slabs, and footings to discourage rodents from burrowing as well as eliminate attractive harborage. Where erosion of bare soil is likely, this buffer can be maintained by installing heavy gravel. To discourage burrowing, install a strip of 1-inch-diameter (2.5-cm) or larger gravel laid in a band at least 2 feet (60 cm) wide and 1/2 foot (15 cm) deep around foundation walls.

3.2 RODENT REMOVAL

- A. Completely remove rodents when approved by the Contracting Officer. Do not use poisons due to the potential for negative environmental or health effects.

3.3 CLEANUP OF RODENT URINE, DROPPINGS, AND CONTAMINATED SURFACES

- A. Prior to cleaning areas such as sheds, outbuildings, or attics, ventilate the area by opening doors or windows to the outdoors for at least 30 minutes. Provide cross ventilation where possible.
- B. Utilize appropriate PPE.
- C. Spray all rodent urine and dropping with a disinfectant or chlorine solution until thoroughly soaked.
- D. To avoid generating potentially infectious aerosols, do not vacuum or sweep rodent urine, droppings, or contaminated surfaces until they have been disinfected.
- E. Use a paper towel to absorb the urine and pick up the droppings. Place the paper towel in the garbage.

- F. After the rodent droppings and urine have been removed, disinfect items that might have been contaminated by rodents or their urine and droppings.
 - 1. Mop floors with a disinfectant or chlorine solution.
 - 2. Disinfect countertops, cabinets, drawers, and other durable surfaces with a disinfectant or chlorine solution.
 - 3. Disinfect carpets with a disinfectant or with a commercial-grade steam cleaner or shampoo.
 - 4. Steam-clean or shampoo rugs and upholstered furniture.
 - 5. Leave books, papers, and other items that cannot be cleaned with a liquid disinfectant or thrown away, outdoors in the sunlight for several hours, or in an indoor area free of rodents for approximately 1 week before cleanup. After that time, the virus should no longer be infectious. However, to further reduce risk, wear rubber, latex, vinyl, or nitrile gloves and wipe the items with a cloth moistened with disinfectant.

3.4 CLEAN UP OF DEAD RODENTS AND RODENT NESTS

- A. Utilize appropriate PPE.
- B. Use insect repellent (containing DEET) on clothing, socks, and arms to reduce the risk of fleabites that might transmit plague.
- C. Spray dead rodents and rodent nests with a disinfectant or a chlorine solution, soaking them thoroughly. Wait 10 minutes before disturbing to ensure inactivation of the virus.
- D. Place the dead rodent or nest in a plastic bag or remove the dead rodent from the trap and place it in a plastic bag. When cleanup is complete (or when the bag is full), seal the bag, place it into a second plastic bag, and seal the second bag. Dispose of the material in the double bag by burning it or discarding it in a covered trash can that is regularly emptied.
- E. Clean up the surrounding area as described in Section 3.3 - Cleanup of Rodent Urine and Droppings and Contaminated Surfaces above.

3.5 VERIFICATION OF RODENT EXCULSION ACTIVITIES

- A. Contractor shall procure the services of a third-party rodent exclusion specialist to verify rodent exclusion activities.
- B. Third-party specialist shall document the measures taken to prevent rodents from entering the structure and an opinion of effectiveness.
- C. A review of the completed structures shall be conducted by specialist prior to closeout to confirm that rodent exclusion measures are in place throughout the project.

END OF SECTION 13 80 00

SECTION 11 10 00 – BARRIER GATE ARM OPERATOR

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pre-wired barrier arm gate operator, including all selected attachments and accessory equipment.

1.2 SUBMITTALS

- A. Shop drawings: Submit shop drawings under the provisions of Section 01 33 00 “Submittal Procedures.” Submit drawings showing connections to adjacent construction, range of travel, and all electrical and mechanical connections to the operator. All underground runs of electrical lines and inductive vehicle obstruction loop locations shall be indicated on drawings. Drawings shall also show the size and location of the concrete mounting pad.
- B. Installation instructions: Submit two copies of manufacturer's installation instructions for this specific project.
- C. Submit manufacturer’s completed warranty registration form to Contracting Officer.
- D. Project list: Submit list of product installations comparable to the subject job. Include date of product installation, installer, and project name and location of the project.
- E. Test reports:
 - 1. Submit affidavits from the manufacturer demonstrating that the gate operator mechanism has been tested to 2 million cycles without breakdown.
 - 2. Each operator shall bear a label indicating that the operator mechanism has been tested to full power stress of all mechanical components and electrical tests of all overload devices.

1.3 CODES AND REGULATORY REQUIREMENTS

- A. Operators shall be built to UL 325 standards and be listed by a nationally recognized testing laboratory. Complete all electrical work according to local codes and National Electrical code. All fieldwork shall be performed in a neat and professional manner, completed to journeyman standards.
- B. Vehicular gates should never be used by pedestrians. A separate pedestrian gate must always be provided when foot traffic is present.
- C. Current safety standards require gate operators to be designed and labeled for specific usage classes.

1.4 PRODUCT DELIVERY AND STORAGE

- A. Store products upright in the original shipping containers, covered, ventilated and protected from all weather conditions.

1.5 QUALITY ASSURANCE

- A. Manufacturer: A company specializing in the manufacture of gate operators of the type specified, with a minimum of five years of experience manufacturing gate operators of this type and design.
- B. Installer: Must have a minimum of three years’ experience installing similar equipment, provide proof of attending manufacturer’s training within the previous three years, or obtain

other significant manufacturer endorsement of technical aptitude, if required, during the submittal process.

1.6 WARRANTY

- A. Provide a warranty against all defects in materials or workmanship for two years or 1,000,000 gate cycles (whichever occurs first) after the date of installation. Defective materials shall be replaced at manufacturer's discretion with new or reconditioned materials furnished by the manufacturer, at no cost to the Government. Freight, labor and other incidental costs are not covered under the factory warranty but may be covered by a separate service agreement between installing company and the Government.

PART 2 PRODUCTS

2.1 GATE OPERATORS

1. Manufacturer

- A. Basis of Design: HySecurity gate operator model StrongArmPark DC with Smart DC Controller,
- B. Other comparable operator, as approved by the Contracting Officer

2.2 PERFORMANCE REQUIREMENTS

- A. Operation shall be by means of a brushed DC electric motor with an integral primary spur gear reducer driving a single reduction gear reducer with the gate arm mount fixed to the output shaft via a splined connection. The motor shall contain an integral position feedback encoder such that limits are set in software. The design shall include provisions for re-establishing previously set limits in the event of power failure. Operator shall be capable of handling arms up to 14 ft (4,267m) in length made from extruded aluminum, wood, or PVC. Travel time adjustable as fast as 2.5 seconds from fully closed to fully open position. Maximum arm length shall be 14 ft (4,267 mm). Gate Operator shall operate in the event of a power failure in an uninterruptible power supply mode to the extent the two 8Ah batteries can maintain adequate power
- B. Minimum standard mechanical components
 1. Chassis: shall be 14 gauge (2 mm) galvanized steel.
 2. Cover: shall be 14 gauge (2 mm) galvanized steel with keyed lock.
 3. Finish: Textured TGIC polyester powder coat finish in white, proven to withstand 1,000 hour salt spray test.
 4. Gear Reducer: filled with synthetic lubricant allowing operation down to -13° F (-25° C) without a heater.
 5. Gear Reducer: #60 with splined output shaft.
 6. Arm striping shall be highly reflective alternating red and white vertical stripes, 16" (406 mm) intervals measured horizontally per MUTCD standards
- C. Minimum standard electrical components:
 1. Motor: 140W minimum with integral gearbox and Hall effect sensors.
 2. Hall effect sensor for detection of output shaft position.
 3. Controls: Smart DC Controller Board containing:
 - a. inputs for tenant, transient, and special users
 - b. 32 character LCD for reporting of functions and codes with 5 button user interface;
 - c. multiple programmable output relay options including vehicle counts, arming

- signals, wrong-way and back-out signals.
- d. anti-tailgate mode;
- e. built-in power surge/lightning strike protection;
- f. multi-stage intelligent battery charging under microprocessor control;
- g. menu configuration, event logging and system diagnostics;
- h. Port for connection to laptop or other computer peripheral and connection for network interface;
- i. dual gate communication connection for bi-parting, sally port, or sequenced gates;
- j. electromechanical and solid state relays;
- k. radio option outputs;
- l. 15 inputs for site specific configurations;
- 4. Transformer: 250 VA, dual voltage.
- 5. Input power: 115V, 208V/230V Field selectable.
- 6. Accessory power: 12 VDC, 24 VDC
- D. External sensors for stopping or reversing the barrier or arm travel: arm edge sensor.
- E. Control devices: card reader and emergency vehicle open device.
- F. Stop switch, hold open/hold close switch.
- G. Communications package delivering Internet Protocol (RJ-45 copper or SFP fiber), managed switch and web based interface to operator.
- H. Arm: "1 1/2" (38 mm) x 3 1/4" (82 mm) single piece aluminum arm 10 ft (3,048 mm) contains LED light strip on top surface and rubber bumper on lower surface. Arm to be mounted to a hinged mount with a proximity sensor that stops further arm movement and is capable of sending a signal indicating the arm has been hit.

2.4 FACTORY TESTING

- A. Fully assemble and test, at the factory, each gate operator to assure smooth operation, sequencing and electrical connection integrity.
- B. Check all mechanical connections for tightness and alignment. Check all welds for completeness and continuity.
- C. Inspect finishes for completeness. Touch up imperfections prior to shipment.
- D. Check all electrical wires to assure that chafing cannot occur during shipping or operation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that foundation, mechanical and electrical utilities, and placed anchors are in correct position

3.2 INSTALLATION

- A. Install gate operator in accordance with the safety regulations and the manufacturer's product literature and installation instructions, current at the time of installation. Coordinate locations of operators with contract drawings; other trades and shop drawings.
- B. Installer shall ensure that the electrical service to the operator is at least 15A. Electrical wiring to conform to NEC and manufacturer's installation instructions.
 - 1. Basis of Design StrongArmPark DC is 250W.

3.3 FIELD QUALITY CONTROL

- A. Test operator through ten full open and close cycles and adjust for operation without binding, scraping or uneven motion. Test limit switches for proper open and close limit positions.
- B. All anchor bolts shall be fully tightened in the finished installation.
- C. Contracting Officer shall complete "punch list" with installing contractor prior to final acceptance of the installation and submit completed warranty documentation to manufacturer.

3.4 TRAINING

- A. Train Government personnel on how to safely shut off electrical power, release and manually operate the barrier.
- B. Demonstrate the general maintenance of the gate operator and accessories and provide one copy of "Programming and Operations Manual" for the Government's use. Manuals will identify parts of the equipment for future procurement.

END OF SECTION

SECTION 12 24 13 – WINDOW AND DOOR SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. For select windows: Manually operated roller shades with double rollers. Refer to drawings for shade locations.
 - 2. For all exterior with vision glass lite:
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
 - 2. Section 07 92 00 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Samples: For each exposed product and for each color and texture specified, 10 inches long.
- D. Samples for Initial Selection: For each type and color of shade and headbox material.
 - 1. Include Samples of accessories involving color selection.
- E. Product Schedule: For roller shades. Use same window designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Contracting Officer of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH DOUBLE ROLLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Draper, Inc.
 - 2. Hunter Douglas, Inc.
 - 3. Lutron Electronics Co., Inc.
 - 4. MechoShade Systems, LLC.
 - 5. OEM Blinds LLC.
- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - 1. Bead Chains: Manufacturer's standard (No plastic) .
 - a. Loop Length: Full length of roller shade .
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Chain tensioner, jamb or sill mounted .
 - 2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
 - a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
 - 1. Double-Roller Mounting Configuration: Offset, outside roller over and inside roller under

2. Inside Roller:
 - a. Direction of Shadeband Roll: Regular, from back (exterior face) of roller .
 3. Outside Roller:
 - a. Direction of Shadeband Roll: Regular, from back (exterior face) of roller .
 4. Shadeband-to-Roller Attachment: Manufacturer's standard method .
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.
- E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- F. Inside Shadebands:
 1. Shadeband Material: Light-filtering fabric, color and translucence selected from manufacturer's standard selection..
 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material .
 - b. Color and Finish: As selected by Contracting Officer from manufacturer's full range .
- G. Outside Shadebands:
 1. Shadeband Material: Light-blocking fabric .
 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material .
 - b. Color and Finish: As selected by Contracting Officer from manufacturer's full range .
- H. Installation Accessories:
 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 - a. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches .
 2. Endcap Covers: To cover exposed endcaps.
 3. Installation Accessories Color and Finish: As selected by Contracting Officer from manufacturer's full range .

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701 . Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 1. Source: Roller shade manufacturer .
 2. Type: PVC-coated fiberglass with silver backing .
 3. Weave: Basketweave .
 4. Openness Factor: 5 percent.
 5. Color: As selected by Contracting Officer from manufacturer's full range
- C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.
 1. Source: Roller shade manufacturer .

2. As selected by Contracting Officer from manufacturer's full selection.
3. Color: As selected by Contracting Officer from manufacturer's full range .

2.4 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
 1. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

2.5 ENCLOSED BLINDS

- A. Basis of Design: Add-On Blinds for Doors by ODL
 1. Or Approved Equal
- B. Aftermarket Door Accessory providing enclosed shade assembly, mountable to the interior side of insulated hollow metal door
 1. Color: White
 2. Blind Type: Cellular, with mechanical function to draw blind up or down.
 3. Size: Compatible with door lite size as shown on door schedule and coordinated with hollow metal door shop drawings.
 4. Frame Type: Compatible with flush framed door lite, as specified in 08 11 13 "Hollow Metal Doors and Frames." Coordinate with hollow metal door shop drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

- B. Roller Shade Locations: At exterior windows Refer to window schedule for locations.

3.3 DOOR SHADE INSTALLATION

- A. Install shades level, plumb, and aligned with door lite according to manufacturer's written instructions.
- B. Locations: At exterior doors with lites. Refer to door schedule for locations.
- C. When installing, confirm mounting location does not interfere with safe door hardware function.

3.4 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.5 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Contracting Officer, before time of Substantial Completion.

END OF SECTION 12 24 13

SECTION 12 32 16 - MANUFACTURED PLASTIC-LAMINATE-CLAD CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pre-manufactured plastic-laminate-clad casework (cabinets in break room and open office).
 - 2. Casework hardware and accessories.
 - 3. Motorized Adjustable Work Surface

- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wood blocking for anchoring casework.
 - 2. Section 06 41 16 "Plastic Laminate Clad Architectural Cabinets" for custom and built-in furnishings.
 - 3. Section 12 36 61.19 "Quartz Agglomerate Countertops."

1.2 DEFINITIONS

- A. Definitions in the AWI/AWMAC/WI's "Architectural Woodwork Standards" apply to the Work of this Section.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .

1.4 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that casework can be supported and installed as indicated.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For plastic-laminate-clad casework.
 - 1. Include plans, elevations, sections, and attachments to other work including blocking and reinforcements required for installation.
 - 2. Indicate types and sizes of casework.
 - 3. Indicate manufacturer's catalog numbers for casework.
 - 4. Show fabrication details, including types and locations of hardware.
 - 5. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and equipment.
 - 6. Apply AWI's Quality Certification Program label to Shop Drawings.

- C. Samples for Verification: For the following:
 - 1. Plastic Laminates: 8 by 10 inches for each type, color, pattern, and surface finish required.

- a. Provide one Sample applied to core material with specified edge material applied to one edge.
2. Provide representative samples for selection of hardware finishes.

1.6 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Quality Standard Compliance Certificates: AWI's Quality Certification Program certificates.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer or Licensed participate in AWI's Quality Certification Program .

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during remainder of construction period. Maintain temperature and relative humidity during remainder of construction period in range recommended for Project location by the AWI/AWMAC/WI's "Architectural Woodwork Standards."
- B. Field Measurements: Where casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.
- C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before enclosing them, and indicate measurements on Shop Drawings.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Delamination of components or other failures of glue bond.
 - b. Warping of components.
 - c. Failure of operating hardware.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CASEWORK

- A. Quality Standard: Unless otherwise indicated, comply with the AWI/AWMAC/WI's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.
 - 1. Grade: Custom .
 - 2. Provide labels and certificates from AWI certification program indicating that casework complies with requirements of grades specified.
 - a. Contractor shall register the Work under this Section with AWI's Quality Certification Program at www.awiqcp.org or by calling 855-345-0991.
- B. Certified Wood: Verify wood products are made from certified wood tracked through a chain-of-custody process. Provide certified wood documentation from sources certified through a forest certification system with principles, criteria, and standards developed using ISO/IEC Guide 59 or the World Trade Organization's "WTO Agreement on Technical Barriers to Trade."
- C. Product Designations:
 - 1. Drawings indicate sizes, configurations, and finish materials of manufactured plastic-laminate-clad casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish materials, and complying with the Specifications may be considered. See Section 01 60 00 "Product Requirements."
 - 2. Drawings indicate configurations of manufactured plastic-laminate-clad casework by referencing designations of Casework Design Series numbering system in the Appendix of the AWI/AWMAC/WI's "Architectural Woodwork Standards."

2.2 PLASTIC-LAMINATE-CLAD CASEWORK

- A. Design: Face-frame cabinet construction with the following door and drawer-front style:
 - 1. Reveal overlay.
- B. Plastic Laminate Colors:
 - 1. Lower Cabinets Basis of Design Color: Formica Faux Gauze
 - 2. Upper Cabinets Basis of Design Color: Wilsonart Shadow
- C. Exposed Materials:
 - 1. Plastic-Laminate Grade: HGS .
- D. Semiexposed Materials:
 - 1. Plastic Laminate: Grade VGS unless otherwise indicated. Provide plastic laminate for semiexposed surfaces unless otherwise indicated.
 - a. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.
- E. Concealed Materials:
 - 1. Plastic Laminate: Grade BKL.

2.3 CASEWORK HARDWARE AND ACCESSORIES

- A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish , commercial-quality, heavy-duty hardware.
 - 1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
- B. Butt Hinges: Stainless steel , semiconcealed, five-knuckle hinges complying with ANSI/BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide two hinges for doors less than 48 inches high, and provide three hinges for doors more than 48 inches high.
- C. Drawer and Cabinet Pulls: Back mounted, solid metal, 6 inches long, 1-1/4 inches deep, and 11/16 inch in diameter.
 - 1. Basis of Design: Amerock BP55277ORB
 - 2. Color/Finish: Oil Rubbed Bronze
 - 3. Hole Spacing: 5"
- D. Drawer Slides: ANSI/BHMA A156.9.
 - 1. Basis of Design: Accuride ST2800, Side-mount Roller-bearing slide.
 - 2. Heavy-Duty (Grade 1HD-200):Side mount .
 - a. Type: Full extension.
 - b. Material: Stainless steel slides.
 - c. Motion Feature: Gravity-activated self-closing mechanism.
- E. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- F. Door and Drawer Bumpers: Self-adhering, clear silicone rubber.
 - 1. Doors: Provide one bumper at top and bottom of closing edge of each swinging door.
 - 2. Drawers: Provide one bumper on back side of drawer front at each corner.
- G. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
 - 1. Dark, Oxidized, Satin Bronze, Oil Rubbed: ANSI/BHMA 613 for bronze base; ANSI/BHMA 640 for steel base; match Contracting Officer's sample.
- H. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.
- I. Adjustable Shelf Supports
 - 1. Adjustable Shelf Supports: Pin-type, two-pin-locking plastic shelf rests complying with ANSI/BHMA A156.9, Type B04013 .

2.4 MOTORIZED ADJUSTABLE WORK SURFACE

- A. Basis of Design Product: Bivi Height Adjustable Desk
- B. Required features:
 - 1. Nominal Size of Unit: 30 inches x 42 inches.
 - 2. HPL (High Pressure Laminate) clad wood core top, min 1" thick.
 - 3. Side edges: PVC free, 3 mm, flat edge profile.
 - 4. Motorized with electronic synchronization drive; 24V DC; height adjustment rate 1.3 inch/second, 9' power cord.

5. Push button controller; 4 minimum digital preset heights.
6. Adjustable height from 28.3" to 46.9"; continuous/in any increment.
7. Maximum distributed weight capacity of 250 pounds.
8. Leg Configuration: T-shape.
9. Levelling guides
10. Obstruction sensing feature.
11. Under Worksurface Utility Power: 2 power, 1 USB-A
12. Under Worksurface Cable Control Accessory
13. Straight Screen Accessory: 42" wide.

2.5 MATERIALS

- A. Composite Wood Products: Verify products are made without added urea formaldehyde.
- B. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
- C. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.
- D. Softwood Plywood: DOC PS 1.
- E. Particleboard: ANSI A208.1, Grade M-2.
- F. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130 .
- G. Hardboard: ANSI A135.4, Class 1 tempered.
- H. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Formica Corporation.
 - b. Laminart LLC.
 - c. Nevamar Company, LLC.
 - d. Pionite; a Panolam Industries International, Inc. brand.
 - e. Wilsonart LLC.
 2. Source Limitations: Obtain from single source from single manufacturer.
- I. PVC Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3.0 mm thick at doors and drawer fronts, 1.0 mm thick elsewhere.
- J. Thermally Fused Laminate Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
 1. Edgebanding for Thermally Fused Laminate (TFL) Panels: PVC or polyester edgebanding matching thermally fused laminate panels.
- K. Adhesives: Do not use adhesives that contain urea formaldehyde.

2.6 FABRICATION

- A. Plastic-Laminate-Clad Cabinet Construction: As required by referenced quality standard, but not less than the following:
 - 1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch particleboard.
 - 2. Shelves: 3/4-inch- thick particleboard .
 - 3. Backs of Casework: 1/2-inch- thick particleboard or MDF where exposed, 1/4-inch-thick, veneer-core hardwood plywood dadoed into sides, bottoms, and tops where not exposed.
 - 4. Drawer Fronts: 3/4-inch particleboard.
 - 5. Drawer Sides and Backs: 1/2-inch- thick solid-wood or veneer-core hardwood plywood , with glued dovetail or multiple-dowel joints.
 - 6. Drawer Bottoms: 1/4-inch- thick particleboard or MDF glued and dadoed into front, back, and sides of drawers. Use 1/2-inch material for drawers more than 24 inches wide.
 - 7. Drawer Bodies: Steel drawer pans formed from 0.0359-inch- thick metal, metallic phosphate treated, and finished with manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat with a minimum dry film thickness of 1 mil for topcoat and 2 mils for system.
 - 8. Doors 48 Inches High or Less: 3/4 inch thick, with particleboard or MDF cores.
 - 9. Doors More Than 48 Inches High: cores.
- B. Filler Strips: Provide as needed to close spaces between casework and walls, ceilings, and equipment. Fabricate from same material and with same finish as casework.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install casework level, plumb, and true in line; shim as required using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- C. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten cabinets to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch.

- D. Fasten casework to adjacent units and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI/AWMAC/WI's "Architectural Woodwork Standards."
- E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- F. Adjust operating hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
 - 1. Inspection entity shall prepare and submit report of inspection.

3.4 CLEANING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Contracting Officer.

END OF SECTION 12 32 16

SECTION 12 36 61.19 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Quartz agglomerate countertops.

1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials and solid surface sills.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
 - 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.
- C. Samples for Initial Selection: For each type of material exposed to view.
 - 1. Provide physical samples, 3 inch x 3 inch minimum size, of manufacturer's range of colors for selection by Contracting Officer.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.4 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

1.5 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of polymers, resins, and pigment and complying with ISFA 3-01.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Formica
 - b. Cambria.
 - c. Transolid.
 - d. Vicostone USA.
 - e. Wilsonart LLC.
 - 2. Basis of Design Color: Formica Bianco Mineral

- B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 FABRICATION

- A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Custom.
- B. Configuration:
 - 1. Front: As shown on drawings.
 - 2. Backsplash: Straight, slightly eased at corner .
- C. Countertops: 3/4-inch- thick, quartz agglomerate with front edge built up with same material.
- D. Backsplashes: 1/2-inch- thick, quartz agglomerate.
- E. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
- F. Joints:
 - 1. Fabricate countertops in sections for joining in field, with joints determined by manufacturer's advised location .
 - a. Joint Locations: Not within 18 inches of a sink and not where a countertop section less than 36 inches long would result, unless unavoidable.
 - b. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.
- G. Cutouts and Holes:
 - 1. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by quartz agglomerate manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- C. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
 - 1. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- F. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- G. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION 12 36 61.19

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The plans and specifications are complimentary and shall be used together in order to fully describe the Work. In the case of a conflict between the plans and specifications, the plans take precedence.
- B. The engineer has based the drawings and design on non-certified information furnished by various equipment manufacturers. It is incumbent on the part of the CONTRACTOR to include in the bid all material and labor needed to install the actual equipment furnished.
- C. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 REFERENCES

- A. Applicable Standards:

1. American Society for Testing and Materials (ASTM):
 - a. A47 - Ferritic Malleable Iron Castings.
 - b. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - c. A126 - Gray Iron castings for Valves, Flanges, and Pipe Fittings.
 - d. A536 - Ductile Iron Castings.
 - e. B32 - Solder Metal.
 - f. C1107 - Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 - g. D709 - Laminated Thermosetting Materials.

2. American Society of Mechanical Engineers (ASME):
 - a. Boiler and Pressure Vessel Code.
 - b. A13.1 - Scheme for the Identification of Piping Systems.
 - c. B1.20.1 - Pipe Threads, General Purpose (Inch).
 - d. B16.20 - Ring-Joint Gaskets and Grooves for Steel Pipe Flanges.
 - e. B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.
 - f. B18.2.1 - Square and Hex Bolts and Screws-Inch Series.
 - g. B31 Series - Code for Pressure Piping.

3. American Welding Society (AWS):
 - a. Soldering Manual, latest.
 - b. Brazing Manual, latest.
 - c. A5.8 - Filler Metals for Brazing.
 - d. D1.1 - Structural Welding Code for Steel.
 - e. D10.12 - Recommended Practices and Procedures for Welding Low Carbon Steel Pipe.

1.5 SUBMITTALS

- A. Submit manufacturer's data sheets on all system components, including the following:
- B. General, all Division 22 sections of the Specifications: Follow the procedures specified in Division 01. Prepare maintenance manuals in accordance with Division 01.
- C. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" article of this section.

1.6 CLOSE OUT SUBMITTALS

- A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

- A. Qualify welding processes and operators for structural steel according to AWS D1.1.
- B. All welding on pressure piping shall conform with the requirements of the American National Standard Code for Pressure Piping, ANSI B31.3, "Chemical Plant and Petroleum Refinery Piping." All welds on piping having working pressures of 300 psig or greater shall be subjected to a full X-ray examination and will not be accepted until all welds meet the requirements of

ANSI B31.1, "Power Piping." Faulty welds shall be removed at no additional cost to Contracting Officer. X-ray testing shall be performed by others at no additional cost to the Contractor.

1. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
- C. Pressure Vessels: Prior to installation and acceptance, any power boiler, low-pressure heating boiler, or unfire pressure vessel operated at pressures of 15 pounds per square inch or greater, furnished under this contract will be stamped with ASME Boiler and Pressure Vessel Code Symbol and a National Board of Boiler and Pressure Vessel Inspector's number, thus certifying that the vessel has been fabricated and tested per the provisions of the ASME Boiler and Pressure Vessel Code. Manufacturers' data reports (unless exempted by the ASME Code) will be filed with the National Board in Columbus, Ohio. Two copies of these data reports shall be submitted to Contracting Officer. Testing, certification, and registration will be at the expense of the Contractor.
- D. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- E. Materials and equipment furnished by others.

1.9 PROJECT SITE CONDITIONS

- A. Altitude Ratings: Unless otherwise noted, all specified equipment capacities, air quantities, etc., are for an altitude of 3,000 feet above sea level. Adjustments to manufacturers' ratings must be made accordingly.

1.10 SEQUENCING AND SCHEDULING

- A. Coordinate plumbing equipment installation with other building components.

- B. Arrange for chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- E. Interruption of Plumbing Utilities:
 - 1. The Contractor shall not interrupt any main interior or exterior plumbing utility without written request for an outage and a subsequent approval of PARK Construction Manager nor shall he interrupt any branch line to an outlet or item of equipment without approval from the PARK Construction Manager.
 - 2. Written request for outages shall be submitted seven calendar days in advance of the outage date. This request will delineate the particular utility or service in question, the time the service will be interrupted and the approximate hours the utility shall be off.
 - 3. Unless otherwise noted on the drawings, or directed, any tie-ins or connections to existing utilities or equipment that necessitate interruptions of service shall be performed on a during non standard hours
 - 4. The work to be performed during the interruption, will be preceded by all possible preparation, and will be carefully coordinated to minimize the duration of the interruption and work will proceed continuously until the system is restored to normal.
 - 5. Unless otherwise directed, the manipulation of existing main valves to isolate piping, the shutdown of equipment will be done by PARK maintenance personnel.
- F. Coordinate installation of identifying devices after completion of covering and painting, where devices are applied to surfaces. Install identifying devices prior to installation of acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe and Pipe Fittings:
 - 1. Refer to individual piping system specification sections for pipe and fitting materials and joining methods.
 - 2. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- B. Joining Materials:
 - 1. Refer to individual piping system specification sections in Division 22 for special joining materials not listed below.
 - 2. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.

- a. ASME B16.21 - Nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, except where thickness or specific material is indicated.
 - 1) Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
 - 2) Narrow-Face Type: For raised-face, class 250 cast-iron and steel flanges.
 - b. ASME B16.20 - For grooved, ring-joint, steel flanges.
 - c. AWWA C110 - Rubber, flat face, 1/8-inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.
3. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.
 4. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.
 5. Solder Filler Metal: ASTM B32.
 - a. Alloy Sn95 or Alloy Sn94: Tin (approximately 95%) and silver (approximately 5%), having 0.10% lead content.
 - b. Alloy E: Tin (approximately 95%) and copper (approximately 5%), having 0.10% maximum lead content.
 - c. Alloy HA: Tin-antimony-silver-copper-zinc, having 0.10% maximum lead content.
 - d. Alloy HB: Tin-antimony-silver-copper-nickel, having 0.10% maximum lead content.
 - e. Alloy Sb5: Tin (95%) and antimony (5%), having 0.20% maximum lead content.
 6. Brazing Filler Metals: AWS A5.8.
 - a. BCuP Series: Copper-phosphorous alloys.
 - b. BAgl: Silver alloy.
 7. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
 8. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.
 9. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end, pressure pipes.
 - a. Sleeve: ASTM A126, Class B, gray iron.
 - b. Followers: ASTM A47, Grade 32510 or ASTM A536 ductile iron.
 - c. Gaskets: Rubber.
 - d. Bolts and Nuts: AWWA C111.
 - e. Finish: Enamel paint.

C. Piping Specialties:

1. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
 - a. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
 - b. Insulating Material: Suitable for system fluid, pressure, and temperature.
 - c. Dielectric Unions: Factory-fabricated, union assembly, for 250 psig minimum working pressure at 180°F temperature.

- d. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig minimum pressure to suit system pressures.
 - e. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1) Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.
 - 2) Dielectric Couplings: Galvanized steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225°F temperature.
 - 3) Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive, thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig working pressure at 225°F temperature.
2. Mechanical Sleeve Seals: Modular, watertight, mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.
 3. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 - a. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.
 - b. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with one mechanical joint end conforming to AWWA C110 and one plain pipe sleeve end.
 - 1) Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 2) Designed to form a hydrostatic seal of 20 psig minimum.
 - 3) Sealing Elements: EPDM-rubber or High-temperature-silicone or Nitrile (Buna N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 4) Pressure Plates: Composite plastic.
 - 5) Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633 or Stainless steel or Stainless steel, Type 316 of length required to secure pressure plates to sealing elements.
 - c. Cast-Iron Sleeve Fittings: Commercially made sleeve having integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.

D. Escutcheons

1. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
 - a. One Piece, Deep-Pattern Type: Deep-drawn, box shaped brass with polished chrome plated finish.
 - b. One-Piece, Cast-Brass Type: With set screw, Cast-Brass-Type: With concealed hinge and set screw. Finish: Polished chrome plated.
 - c. One-Piece, Floor-Plate Type: Cast-iron floor plate.
 - d. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.
2. Installation:
 - a. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

- b. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
- c. Install floor plates for piping penetrations of equipment-room floors.
- d. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

E. Grout: Nonshrink, Nonmetallic Grout: ASTM C1107, Grade B.

- 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2.2 IDENTIFICATION

A. Valve Tags:

- 1. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - a. Tag Materials: Brass, 0.032-inch minimum thickness, and having pre-drilled or stamped holes for attachment hardware.
- 2. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open or closed), and variations for identification. Mark valves for emergency shutoff and similar special uses.
- 3. Valve tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 ERECTION INSTALLATION APPLICATION

A. Piping Systems - Common Requirements:

- 1. General: Install piping as described below, except where system sections specify otherwise. Individual piping system specification sections in Division 22 specify piping installation requirements unique to the piping system.
- 2. General Locations and Arrangements: Drawings (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, except where deviations to layout are approved on coordination drawings.
- 3. Install piping at indicated slope.
- 4. Install components having pressure rating equal to or greater than system operating pressure.
- 5. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- 6. Install piping free of sags and bends.

7. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.
8. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
9. Install piping to allow application of insulation plus 1-inch clearance around insulation.
10. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
11. Install fittings for changes in direction and branch connections.
12. Escutcheons: Where uncovered exposed pipes pass through floors, finished walls, or finished ceilings, they shall be fitted with chromium-plated cast-brass plates on chromium-plated pipe, or with cast-iron or steel plates on ferrous pipe. Plates shall be large enough to completely close the holes around the pipes and shall be square, octangular, or round, with the least dimension not less than 1-1/2 inches or more than 2-1/2 inches larger than the diameter of the pipe. Plates shall be secured in an approved manner.
13. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated.
14. Above Grade, Exterior Wall, and Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.
 - a. Install steel pipe for sleeves smaller than 6 inches.
 - b. Install cast-iron wall pipes for sleeves 6 inches and larger.
 - c. Assemble and install mechanical seals according to manufacturer's printed instructions.
15. Below Grade, Exterior Wall, and Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.
16. Below Grade, Exterior Wall, and Pipe Penetrations: Install ductile-iron wall penetration system sleeves according to manufacturer's printed installation instructions.
17. Verify final equipment locations for roughing in.
18. Refer to equipment specifications in other sections of these specifications for roughing-in requirements.
19. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system specification sections.
 - a. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - b. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - c. Soldered Joints: Construct joints according to AWS "Soldering Manual."
 - d. Brazed Joints: Construct joints according to AWS "Brazing Manual."
 - e. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
 - f. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
20. Piping Connections: Except as otherwise indicated, make piping connections as specified below.

- a. Install unions, in piping 2 inches and smaller, adjacent to each valve and at final connection to each piece of equipment having 2-inches or smaller threaded pipe connection.
- b. Install flanges, in piping 2-1/2 inches and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
- c. Dry Piping Systems (Gas, Compressed Air, and Vacuum): Install dielectric unions and flanges to connect piping materials of dissimilar metals.
- d. Wet Piping Systems (Water and Steam): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

B. Painting and Finishing:

- 1. Damage and Touch-Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Identification Tags and Labels:

1. Materials:

- a. Tags: Tags shall be aluminum, brass or laminated plastic 2" x 1" minimum with edges ground smooth or rolled. Each tag shall be punched to receive tie wires or chain. Letters and Numbers shall be evenly spaced and stamped or engraved into the surface.

2. Installation:

a. Identification of Piping:

1) Identify all piping according to the following procedures:

- a) Bare pipes to be marked shall first be wiped clean of dirt, dust, grease, and moisture. Markers to be installed on painted piping shall be applied only after completion of final coat of paint. Insulated pipes shall first be painted to a smooth, hard surface in the area the label is to be applied. Labels shall be applied, using pressure, so that it lies smooth and flat. After application on insulated pipes, the label shall be stapled securely to the insulation. The labels shall be applied to the pipe so that the lettering is in the most legible position. For overhead piping apply markers on the lower half of the pipe where view is unobstructed, so that markers can be read at a glance from floor level. The wording on the labels shall correspond directly to the wording in the mechanical symbol lists, regardless of whether or not it is standard wording for the designated manufacturer.
- b) Use an arrow marker with each pipe content marker. The arrow shall always point away from the pipe marker and in the direction of flow, with background color and height the same as content marker. If flow can be in both directions, use two arrow markers.
- c) Apply pipe marker and arrow marker at each valve, at every point of pipe entry or exit through wall or ceiling, on each riser and branch of tee, and every 20 feet on long continuous lines or at every bay or aisle to show proper identification of pipe content and direction of flow.

- b. Valves: All main service valves, including fire protection, located inside the building shall be tagged and identified as to the type of service. All valves controlling branch mains or risers to various portions of the building shall be tagged and identified as to the areas served.

- c. Controls: All automatic controls, control panels, zone valves, pressure electric, electric pressure switches, relays and starters shall be clearly tagged and identified. Wording shall be identical to that on the control diagram in the contract drawings.
- d. Pumps: All pumps shall be identified as to service with aluminum or brass tags secured by tie wires.

D. Erection of Metal Supports and Anchorage:

- 1. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- 2. Field Welding: Comply with AWS D1.1 "Structural Welding Code - Steel."

E. Cutting and Patching:

- 1. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for plumbing installations. Perform cutting by skilled mechanics of the trades involved.
- 2. Repair cut surfaces to match adjacent surfaces.

F. Grouting:

- 1. Install nonmetallic, nonshrink grout for plumbing equipment base bearing surfaces, pump and other equipment base plates and anchors. Mix grout according to manufacturer's printed instructions.
- 2. Clean surfaces that will come into contact with grout.
- 3. Provide forms for placement of grout, as required.
- 4. Avoid air entrapment when placing grout.
- 5. Place grout, completely filling equipment bases.
- 6. Place grout on concrete bases to provide a smooth bearing surface for equipment.
- 7. Place grout around anchors.
- 8. Cure placed grout according to manufacturer's printed instructions.

END OF SECTION 22 05 00 – COMMON WORK RESULTS FOR PLUMBING

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.
 - 4. Silicone sealants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description:
 - 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 2. Designed to form a hydrostatic seal of 20 psig minimum.

3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Carbon steel.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Cut sleeves to length for mounting flush with both surfaces.
 2. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

END OF SECTION 220517

SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- D. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

2.2 FLOOR PLATES

- A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:

- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
 - d. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
2. Escutcheons for Existing Piping to Remain:
- a. Chrome-Plated Piping: Split-casting, stamped steel with concealed hinge with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: Split floor plate.
 - 2. Existing Piping: Split floor plate.

3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING

SECTION 22 05 19 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
 - 1. Standard: ASME B40.200.
 - 2. Case: Cast aluminum; 6-inch nominal size.
 - 3. Case Form: Back angle unless otherwise indicated.
 - 4. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.

6. Window: Glass or plastic.
7. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
8. Connector: 3/4 inch, with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Standard: ASME B40.200.
2. Case: Plastic; 6-inch nominal size.
3. Case Form: Back angle unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue or red organic liquid.
5. Tube Background: Nonreflective with permanently etched scale markings graduated in deg F.
6. Window: Glass or plastic.
7. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
8. Connector: 3/4 inch, with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Sealed type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Ring: Metal.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Sealed type; plastic; 4-1/2-inch nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids.

- H. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
- I. Install pressure gages in the following locations:
 - 1. Building water service entrance into building.
 - 2. Inlet and outlet of each pressure-reducing valve.
 - 3. Suction and discharge of each domestic water pump.
- J. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- K. Adjust faces of meters and gages to proper angle for best visibility.

3.2 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
 - 1. Metal or Plastic case, compact-style, liquid-in-glass type.
- B. Thermometer stems shall be of length to match thermowell insertion length.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.
- B. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F.

3.4 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be one of the following:
 - 1. Sealed, direct-mounted, metal case.
 - 2. Sealed, direct-mounted, plastic case.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
 - 1. Sealed, direct-mounted, metal case.
 - 2. Sealed, direct-mounted, plastic case.
 - 3. Test plug with EPDM self-sealing rubber inserts.
- C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:
 - 1. Sealed, direct-mounted, metal case.
 - 2. Sealed, direct-mounted, plastic case.
 - 3. Test plug with EPDM self-sealing rubber inserts.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 160 psi.
- B. Scale Range for Domestic Water Piping: 0 to 100 psi.

END OF SECTION 22 05 19 - METERS AND GAGES FOR PLUMBING PIPING

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SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bronze ball valves.
 - 2. Bronze swing check valves.
 - 3. Iron swing check valves.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Handlever: For quarter-turn valves NPS 6 and smaller.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.
4. Pressure-Seal-Joint: With EPDM-rubber, O-ring seal in each end.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Or Equal
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless Steel.
 - i. Ball: Stainless Steel.
 - j. Port: Full.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.

- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Red-White Valve Corporation.
- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- l. Zy-Tech Global Industries, Inc.
- m. Or Equal

- 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - j. Or Equal
- 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.4 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.

- d. Hammond Valve.
- e. Kitz Corporation.
- f. Legend Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Red-White Valve Corporation.
- k. Sure Flow Equipment Inc.
- l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- m. Zy-Tech Global Industries, Inc.
- n. Or Equal

- 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Or Equal
- 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Composition.
 - g. Seat Ring: Bronze.
 - h. Disc Holder: Bronze.
 - i. Disc: PTFE or TFE.
 - j. Gasket: Asbestos free.

2.5 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.

- b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Or Equal
2. Description:
- a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and weight.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
 - 2. Throttling Service: Ball valves.
 - 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.

- b. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For PEX Tubing, NPS 2 and Smaller: Threaded ends except where pressure-seal-joint valve-end option is indicated in valve schedules below.
 - 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 5. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends or pressure-seal-joint instead of threaded ends.
 - 2. Bronze Angle Valves: Class 125, bronze disc.
 - 3. Ball Valves: Two piece, full port, bronze with stainless steel trim.
 - 4. Bronze Swing Check Valves: Class 125, bronze or nonmetallic disc.

3.5 SANITARY-WASTE VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Swing Check Valves: Class 125, bronze or nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron Swing Check Valves: Class 125, metal or nonmetallic-to-metal seats.
 - 3. Iron Swing Check Valves with Closure Control: Class 125, lever and weight.

END OF SECTION – 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

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SECTION 22 05 23.12 - BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
 - 1. Certification that products comply with NSF 61 and NSF 372.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 3. ASME B16.18 for solder-joint connections.
 - 4. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valves in Insulated Piping:
 - 1. Include 2-inch stem extensions.
 - 2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.

3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

- A. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Threaded or Soldered Ends:

1. Description:
 - a. Standard: MSS SP-110 or MSS SP-145.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded and soldered.
 - f. Seats: PTFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.

2.3 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:

1. Description:
 - a. Standard: MSS SP-110 or MSS-145.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded and soldered.
 - f. Seats: PTFE.
 - g. Stem: Bronze or brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

3.3 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Brass ball valves, two-piece with full port and brass trim. Provide with threaded or solder-joint ends.
 - 2. Bronze ball valves, two-piece with full port and bronze or brass trim. Provide with threaded or solder-joint ends.

END OF SECTION 22 05 23.12 - BALL VALVES FOR PLUMBING PIPING

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SECTION 22 05 23.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bronze swing check valves.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
 - 1. Certification that products comply with NSF 61.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.18 for solder joint.
- C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

- A. Bronze Swing Check Valves with Bronze Disc, Class 125:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.

- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B62, bronze.
- e. Ends: Threaded or soldered. See valve schedule articles.
- f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:

- 1. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B62, bronze.
 - e. Ends: Threaded or soldered. See valve schedule articles.
 - f. Disc: PTFE.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow in horizontal position with hinge pin level.

3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. End Connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered or press-ends.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze swing check valves bronze or nonmetallic disc, Class 125, with soldered or threaded end connections.
2. Bronze swing check valves with press-end connections.

END OF SECTION 22 05 23.14 - CHECK VALVES FOR PLUMBING PIPING

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SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Carlton Industries, LP.
 - d. Champion America.
 - e. Craftmark Pipe Markers.
 - f. emedco.
 - g. Kolbi Pipe Marker Co.
 - h. LEM Products Inc.
 - i. Marking Services, Inc.
 - j. Seton Identification Products.
 - k. Or Equal
 2. Material and Thickness: Brass, 0.032-inch or stainless steel, 0.025-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 3. Letter Color: Black or Red.
 4. Background Color: White.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 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-quarters the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws .
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Carlton Industries, LP.
 - d. Champion America.
 - e. Craftmark Pipe Markers.
 - f. emedco.
 - g. Kolbi Pipe Marker Co.
 - h. LEM Products Inc.
 - i. Marking Services, Inc.
 - j. Seton Identification Products.
 - k. Or Equal
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch or 1/8 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: Black or Red.
4. Background Color: White.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. 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-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws .
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

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

D. 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) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.
6. emedco.
7. LEM Products Inc.
8. Marking Sevices Inc.
9. National Marker Company.
10. Seton Identification Products.
11. Stranco, Inc.
12. Or Equal

- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch or 1/8 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Black.
- D. Background Color: Yellow.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. 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-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws .
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
 2. Brady Corporation.
 3. Brimar Industries, Inc.
 4. Carlton Industries, LP.
 5. Champion America.
 6. Craftmark Pipe Markers.
 7. emedco.
 8. Kolbi Pipe Marker Co.
 9. LEM Products Inc.

10. Marking Services Inc.
 11. Seton Identification Products.
 12. Or Equal
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
 - C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
 - D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
 - E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 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. Lettering Size: Size letters according to ASME A13.1 for piping or At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances .

PART 3 - EXECUTION

3.1 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.2 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Pipe Label Locations: 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:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Domestic Water Piping
 - a. Background: Safety green.
 - b. Letter Colors: White.

2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Safety gray.
 - b. Letter Color: Black or White.

END OF SECTION - 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of insulation and jacket indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 COORDINATION

- A. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for

installation of insulation and field-applied jackets and finishes and for space required for maintenance.

- B. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
 - 1. Preformed Pipe Insulation: Type II, Class 1, without jacket.
 - 2. Preformed Pipe Insulation: Type II, Class 2, with factory-applied ASJ jacket.
 - 3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.
- G. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
 - 1. Preformed Pipe Insulation: Type I, Grade A, with factory-applied ASJ.
 - 2. 850 deg F.
 - 3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
- C. Flexible Elastomeric Adhesive: Solvent-based adhesive.
 - 1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
 - 2. Wet Flash Point: Below 0 deg F.
 - 3. Service Temperature Range: 40 to 200 deg F.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- E. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.

2.3 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 - 1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F.

2.4 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
 - 1. Permanently flexible, elastomeric sealant.
 - 2. Service Temperature Range: Minus 58 to plus 176 deg F.
 - 3. Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:
 - 1. Fire- and water-resistant, flexible, elastomeric sealant.
 - 2. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 3. Color: Aluminum.

2.5 ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F.
3. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B209 Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Finish and thickness are indicated in field-applied jacket schedules.
 - b. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - c. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.

- 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane, consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
- F. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with stucco-embossed aluminum-foil facing.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Width: 3 inches.
 2. Thickness: 11.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Width: 3 inches.
 2. Thickness: 6.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
 2. Thickness: 3.7 mils.
 3. Adhesion: 100 ounces force/inch in width.
 4. Elongation: 5 percent.
 5. Tensile Strength: 34 lbf/inch in width.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.

- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inchwide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.9 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Color: Final color as selected by Contracting Officer. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum jackets.

3.10 FIELD QUALITY CONTROL

- A. Contracting Officer will engage a qualified testing agency to perform tests and inspections.
- B. Engage a qualified testing agency to perform tests and inspections.
- C. Perform tests and inspections.
- D. All insulation applications will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Flexible Elastomeric: 2 inches thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. None.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. Aluminum, Stucco Embossed: 0.020 inch thick.

D. Piping, Exposed:

1. Aluminum, Stucco Embossed 0.020 inch thick.

3.16 UNDERGROUND, FIELD-APPLIED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 22 07 19 - PLUMBING PIPING INSULATION

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Copper tube and fittings.
 - 2. Ductile-iron pipe and fittings.
 - 3. Piping joining materials.
 - 4. Transition fittings.
 - 5. Dielectric fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

1.3 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Standard: ASSE 1079.
2. Pressure Rating: 125 psig minimum at 180 deg F.
3. End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- G. Install domestic water piping level without pitch and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. 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.
- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread 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:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- H. Joints for PEX Tubing: Join according to ASTM F 1960 for cold expansion fittings and reinforcing rings.
- I. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Plumbing Fixtures: Cold-supply piping in sizes indicated, but not smaller than that required by plumbing code.

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.9 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close yard hydrants
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
 2. PEX tube.
 - a. Fittings for PEX tube:
 - 1) ASTM F 1960, cold expansion fittings and reinforcing rings.
- E. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L wrought-copper, solder-joint fittings; and soldered joints.

END OF SECTION 22 11 16 - DOMESTIC WATER PIPING

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SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Yard hydrants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61.
- B. Comply with NSF 372 for low lead.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 YARD HYDRANTS

A. Nonfreeze Yard Hydrants:

1. Standard: Self-draining yard hydrants.
2. Pressure Rating: 125 psig.
3. Casing: 1-1/4" galvanized steel pipe.
4. Operating Rod: 3/8" stainless steel pipe.
5. Inlet: NPT 1.
6. Outlet: 3/4" thread complying with ASME B1.20.7.
7. Automatic draining, frost proof.
8. Integral backflow protected.

PART 3 - EXECUTION

3.1 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.2 IDENTIFICATION

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Test each yard hydrant according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
 - 2. Copper tube and fittings.
 - 3. ABS pipe and fittings.
 - 4. PVC pipe and fittings.
 - 5. Specialty pipe fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
- B. Field quality-control reports.

1.4 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water >.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 PVC PIPE AND FITTINGS

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- C. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
- D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

2.5 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 2. Unshielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C 1173.
 - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
 - 3. Shielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C 1460.

- b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- c. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. 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.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.
 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- O. Install aboveground ABS piping according to ASTM D 2661.
- P. Install aboveground PVC piping according to ASTM D 2665.
- Q. Install underground PVC piping according to ASTM D 2321.
- R. Plumbing Specialties:
1. Install backwater valves in sanitary waster gravity-flow piping.
 - a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 3. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs.
1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- C. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- D. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
1. Install transition couplings at joints of piping with small differences in ODs.
 2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.

3.5 VALVE INSTALLATION

- A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping" for general-duty valve installation requirements.
- B. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

- C. Backwater Valves: Install backwater valves in piping subject to backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment." Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 4. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- F. Support vertical runs of cast iron soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Install horizontal backwater valves with cleanout cover flush with floor.
 - 6. Comply with requirements for backwater valves and cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 7. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

- D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
- C. Aboveground, vent piping NPS 4 and smaller shall be the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
- D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. Solid wall or Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

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SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Miscellaneous sanitary drainage piping specialties.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Show fabrication and installation details for frost-resistant vent terminals.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:
 - 1. Standard: ASME A112.14.1.
 - 2. Size: Same as connected piping.
 - 3. Body: Cast iron.

4. Cover: Cast iron with threaded access check valve.
5. End Connections: Hubless.
6. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
7. Extension: ASTM A74, Service Class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Standard: ASME A112.36.2M.
2. Size: Same as connected drainage piping
3. Body Material: Hubless, cast-iron soil pipe test tees required to match connected piping.
4. Closure: Countersunk, cast-iron plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts

1. Standard: ASME A112.36.2M for adjustable housing cleanout.
2. Size: Same as connected branch.
3. Type: Adjustable housing
4. Body or Ferrule: Cast iron.
5. Clamping Device: Required.
6. Outlet Connection: Spigot.
7. Closure: Cast-iron plug.
8. Adjustable Housing Material: Cast iron with setscrews or other device.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
10. Frame and Cover Shape: Round.
11. Top-Loading Classification: Medium Duty.
12. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure Plug:
 - a. Cast iron.
 - b. Countersunk head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
5. Wall Access, Cover Plate: Round, flat, chrome-plated brass cover plate with screw.
6. Wall Access, Frame and Cover: Round nickel-bronze wall-installation frame and cover.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

B. Vent Caps

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping.

1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Assemble open drain fittings and install with top of hub 1 inch above floor.

F. Install deep-seal traps on floor drains and other waste outlets, if indicated.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

- J. Install vent caps on each vent pipe passing through roof.
- K. Install wood-blocking reinforcement for wall-mounting-type specialties.
- L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
 - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Concrete equipment base construction requirements.
 - 3. Equipment nameplate data requirements.
 - 4. Nonshrink grout for equipment installations.
 - 5. Field-fabricated metal and wood equipment supports.
 - 6. Installation requirements common to equipment specification sections.
 - 7. Mechanical demolition.
 - 8. Cutting and patching.
 - 9. Touch-up painting and finishing.
- B. The plans and specifications are complimentary and shall be used together in order to fully describe the Work. In the case of a conflict between the plans and specifications, the plans take precedence.
- C. The engineer has based the drawings and design on non-certified information furnished by various equipment manufacturers. It is incumbent on the part of the CONTRACTOR to include in the bid all material and labor needed to install the actual equipment furnished.
- D. Related Sections:
 - 1. The following is work of Division 26 sections of the Specifications:
 - a. Power supply wiring from power source to power connection on equipment. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
 - b. Interlock wiring between field-installed equipment, except where specified as factory installed. Interlock wiring, as used in this specification, is defined as that wiring between electrically-interlocked equipment for the purpose of controlling one piece or pieces of equipment by the operation (on, off, etc.) of another piece or pieces of associated equipment.
- E. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Park, Contracting Officer or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 2. CPVC: Chlorinated polyvinyl chloride plastic.
 3. PE: Polyethylene plastic.
 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 2. NBR: Acrylonitrile-butadiene rubber.

1.4 REFERENCES

- A. Applicable Standards:
 1. American Society for Testing and Materials (ASTM):
 - a. A47 - Ferritic Malleable Iron Castings.
 - b. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

- c. A126 - Gray Iron castings for Valves, Flanges, and Pipe Fittings.
 - d. A536 - Ductile Iron Castings.
 - e. B32 - Solder Metal.
 - f. C1107 - Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 - g. D709 - Laminated Thermosetting Materials.
2. American Society of Mechanical Engineers (ASME):
- a. Boiler and Pressure Vessel Code.
 - b. A13.1 - Scheme for the Identification of Piping Systems.
 - c. B1.20.1 - Pipe Threads, General Purpose (Inch).
 - d. B16.20 - Ring-Joint Gaskets and Grooves for Steel Pipe Flanges.
 - e. B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.
 - f. B18.2.1 - Square and Hex Bolts and Screws-Inch Series.
 - g. B31 Series - Code for Pressure Piping.
3. American Welding Society (AWS):
- a. Soldering Manual, latest.
 - b. Brazing Manual, latest.
 - c. A5.8 - Filler Metals for Brazing.
 - d. D1.1 - Structural Welding Code for Steel.
 - e. D10.12 - Recommended Practices and Procedures for Welding Low Carbon Steel Pipe.

1.5 SUBMITTALS

- A. Submit manufacturer's data sheets on all system components, including the following:
 - 1. Transition fittings
 - 2. Dielectric fittings
 - 3. Mechanical sleeve seals
 - 4. Escutcheons
- B. General, all Division 23 sections of the Specifications: Follow the procedures specified in Division 1. Prepare maintenance manuals in accordance with Division 1 sections of the Specifications.
- C. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" article of this section.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

- A. Qualify welding processes and operators for structural steel according to AWS D1.1.

- B. All welding on pressure piping shall conform with the requirements of the American National Standard Code for Pressure Piping, ANSI B31.3, "Chemical Plant and Petroleum Refinery Piping." All welds on piping having working pressures of 300 psig or greater shall be subjected to a full X-ray examination and will not be accepted until all welds meet the requirements of ANSI B31.1, "Power Piping." Faulty welds shall be removed at no additional cost to the client. X-ray testing shall be performed by others at no additional cost to the Contractor.
1. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
- C. Pressure Vessels: Prior to installation and acceptance, any power boiler, low-pressure heating boiler, or unfired pressure vessel operated at pressures of 15 pounds per square inch or greater, furnished under this contract will be stamped with ASME Boiler and Pressure Vessel Code Symbol and a National Board of Boiler and Pressure Vessel Inspector's number, thus certifying that the vessel has been fabricated and tested per the provisions of the ASME Boiler and Pressure Vessel Code. Manufacturers' data reports (unless exempted by the ASME Code) will be filed with the National Board in Columbus, Ohio. Two copies of these data reports shall be submitted to the client. Testing, certification, and registration will be at the expense of the Contractor.
- D. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- E. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- F. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

- G. **Manufacturer Qualifications:** A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- H. **Fabricator Qualifications:** A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- I. **Installer Qualifications:** A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- J. **Manufacturer's Technical Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- K. **Factory-Authorized Service Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes ducts and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
- C. Protect flanges, fittings, and ducting/piping specialties from moisture and dirt.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- E. Materials and equipment furnished by others.
 - 1. When equipment or materials are indicated to be furnished by others (F.B.O.) or by Park furnished equipment (PFE) to the CONTRACTOR for installation and connection, the CONTRACTOR shall make a complete check of all materials and furnish a receipt to the Contracting Officer detailing the products received and the condition of the products delivered to him. After executing the receipt and acceptance by the CONTRACTOR, the CONTRACTOR shall assume full responsibility for the safe keeping, handling, and installation of the materials and equipment furnished by others or furnished by Park, until completed installation and final approval by the engineer and Contracting Officer.
 - 2. If the CONTRACTOR fails to issue said receipt it shall be assumed that all equipment and materials were then delivered to the CONTRACTOR in the proper quantities and in perfect condition.

1.9 PROJECT SITE CONDITIONS

- A. Altitude Ratings: Unless otherwise noted, all specified equipment capacities, air quantities, etc., are for an altitude of 3,000 feet above sea level. Adjustments to manufacturers' ratings must be made accordingly.

1.10 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical piping, ducting, and equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- E. Interruption of Mechanical Utilities:
 - 1. The Contractor shall not interrupt any main interior or exterior mechanical utility without written request for an outage and a subsequent approval of Contracting Officer nor shall he interrupt any branch line to an outlet or item of equipment without approval from the Contracting Officer.
 - 2. Written request for outages shall be submitted seven calendar days in advance of the outage date. This request will delineate the particular utility or service in question, the time the service will be interrupted and the approximate hours the utility shall be off.
 - 3. Unless otherwise noted on the drawings, or directed, any tie-ins or connections to existing utilities or equipment that necessitate interruptions of service shall be performed on a during non standard hours
 - 4. The work to be performed during the interruption, will be preceded by all possible preparation, and will be carefully coordinated to minimize the duration of the interruption and work will proceed continuously until the system is restored to normal.
- F. Coordinate installation of identifying devices after completion of covering and painting, where devices are applied to surfaces. Install identifying devices prior to installation of acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe and Pipe Fittings:
 - 1. Refer to individual piping system specification sections for pipe and fitting materials and joining methods.

2. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

B. Joining Materials:

1. See individual piping system specification sections in Division 22 for special joining materials not listed below.
2. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.
 - a. ASME B16.21 - Nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, except where thickness or specific material is indicated.
 - 1) Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
 - 2) Narrow-Face Type: For raised-face, class 250 cast-iron and steel flanges.
 - b. ASME B16.20 - For grooved, ring-joint, steel flanges.
 - c. AWWA C110 - Rubber, flat face, 1/8-inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.
3. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.
4. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.
5. Solder Filler Metal: ASTM B32.
 - a. Alloy Sn95 or Alloy Sn94: Tin (approximately 95%) and silver (approximately 5%), having 0.10% lead content.
 - b. Alloy E: Tin (approximately 95%) and copper (approximately 5%), having 0.10% maximum lead content.
 - c. Alloy HA: Tin-antimony-silver-copper-zinc, having 0.10% maximum lead content.
 - d. Alloy HB: Tin-antimony-silver-copper-nickel, having 0.10% maximum lead content.
 - e. Alloy Sb5: Tin (95%) and antimony (5%), having 0.20% maximum lead content.
6. Brazing Filler Metals: AWS A5.8.
 - a. BCuP Series: Copper-phosphorous alloys.
 - b. BAgl: Silver alloy.
7. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
8. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.
9. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end, pressure pipes.
 - a. Sleeve: ASTM A126, Class B, gray iron.
 - b. Followers: ASTM A47, Grade 32510 or ASTM A536 ductile iron.
 - c. Gaskets: Rubber.
 - d. Bolts and Nuts: AWWA C111.
 - e. Finish: Enamel paint.

C. Piping Specialties:

1. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
 - a. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
 - b. Insulating Material: Suitable for system fluid, pressure, and temperature.
 - c. Dielectric Unions: Factory-fabricated, union assembly, for 250 psig minimum working pressure at 180°F temperature.
 - d. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig minimum pressure to suit system pressures.
 - e. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1) Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.
 - 2) Dielectric Couplings: Galvanized steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225°F temperature.
 - 3) Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive, thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig working pressure at 225°F temperature.
 2. Mechanical Sleeve Seals: Modular, watertight, mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.
 3. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 - a. Steel Pipe: ASTM A53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 - b. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with one mechanical joint end conforming to AWWA C110 and one plain pipe sleeve end.
 - 1) Penetrating Pipe Deflection: 5% without leakage.
 - 2) Housing: Ductile-iron casting having water stop and anchor ring, with ductile-iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
 - 3) Pipe Sleeve: AWWA C151, ductile-iron pipe.
 - 4) Housing-to-Sleeve Gasket: Rubber or neoprene, push-on type, of manufacturer's design.
 - c. Cast-Iron Sleeve Fittings: Commercially made sleeve having integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.
- D. Grout: Nonshrink, Nonmetallic Grout: ASTM C1107, Grade B.
1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000 psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

- A. Refer to Division 1 Section “Cutting and Patching” and Division 02 Section “Selective Structure Demolition” for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to be removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to be abandoned in place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to be removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to be removed and reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to be removed and salvaged: Disconnect and cap services and remove equipment and deliver to Contracting Officer.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 ERECTION INSTALLATION APPLICATION

- A. Mechanical Systems - Common Requirements:
 - 1. General: Install piping and ducting as described below, except where system sections specify otherwise. Individual piping system specification sections in Division 23 specify piping installation requirements unique to the piping system.
 - 2. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of mechanical systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install as indicated, except where deviations to layout are approved on coordination drawings.
 - 3. Install piping at indicated slope.
 - 4. Install components having pressure rating equal to or greater than system operating pressure.
 - 5. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
 - 6. Install ducting and piping free of sags and bends.
 - 7. Install exposed interior and exterior ducting and piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.

8. Install ducting and piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
9. Install ducting and piping to allow application of insulation plus 1-inch clearance around insulation for all exterior insulated ducts and pipes.
10. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
11. Install fittings for changes in direction and branch connections.
12. Escutcheons: Where uncovered exposed pipes and ducts pass through floors, finished walls, or finished ceilings, they shall be fitted with chromium-plated cast-brass plates on chromium-plated pipe, or with cast-iron or steel plates on ferrous pipe. Plates shall be large enough to completely close the openings around the ducts and pipes and shall be square, octangular, or round, with the least dimension not less than 1-1/2 inches or more than 2-1/2 inches larger than the diameter of the duct/pipe. Plates shall be secured in an approved manner.
13. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated.
14. Above Grade, Exterior Wall, and Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.
 - a. Install steel pipe for sleeves smaller than 6 inches.
 - b. Install cast-iron wall pipes for sleeves 6 inches and larger.
 - c. Assemble and install mechanical seals according to manufacturer's printed instructions.
15. Below Grade, Exterior Wall, and Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.
16. Below Grade, Exterior Wall, and Pipe Penetrations: Install ductile-iron wall penetration system sleeves according to manufacturer's printed installation instructions.
17. Verify final equipment locations for roughing in.
18. See equipment specifications in other sections of these specifications for roughing-in requirements.
19. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system specification sections.
 - a. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - b. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - c. Soldered Joints: Construct joints according to AWS "Soldering Manual."
 - d. Brazed Joints: Construct joints according to AWS "Brazing Manual."
 - e. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
 - f. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
20. Piping Connections: Except as otherwise indicated, make piping connections as specified below.

- a. Install unions, in piping 2 inches and smaller, adjacent to each valve and at final connection to each piece of equipment having 2-inches or smaller threaded pipe connection.
- b. Install flanges, in piping 2-1/2 inches and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
- c. Dry Piping Systems (Gas, Compressed Air, and Vacuum): Install dielectric unions and flanges to connect piping materials of dissimilar metals.
- d. Wet Piping Systems (Water and Steam): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

B. Equipment Installation - Common Requirements:

1. Install equipment to provide the maximum possible head room, where mounting heights are not indicated.
2. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the engineer.
3. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
4. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
5. Install equipment giving right-of-way to piping systems installed at a required slope.
6. Shaft Alignment: All motors and pumps (or drives) connected by a shaft coupling, whether factory or field assembled, shall be aligned during installation using a dial indicator applied to both ends of both shafts for a full 360 degrees prior to operation. Alignment of the shafts shall be less than the maximum allowable tolerances as recommended by the coupling or equipment manufacturer. Alignment of shafts shall be rechecked after several hours of operation and equipment has reached operating temperature.

C. Painting and Finishing:

1. Damage and Touch-Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

D. Identification Tags and Labels:

1. Materials:
 - a. Pipe Labels: Pipe labels shall be self-adhesive labels, all temperature Perma-Code pipe markers No. B-500, manufactured by the W. H. Brady Company. The background color code for all markers shall conform to the American National Standard ANSI A-13.1 "Scheme for the Identification of Piping Systems." This standard establishes four basic backgrounds as follows: Yellow for dangerous materials, bright blue for protective materials, red for fire protection equipment, and green for safe materials.
 - b. Tags: Tags shall be aluminum, brass or laminated plastic 2" x 1" minimum with edges ground smooth or rolled. Each tag shall be punched to receive tie wires or chain. Letters and Numbers shall be evenly spaced and stamped or engraved into the surface.

2. Installation:
 - a. Identification of Piping:
 - 1) Identify all piping according to the following procedures:
 - a) Bare pipes to be marked shall first be wiped clean of dirt, dust, grease, and moisture. Markers to be installed on painted piping shall be applied only after completion of final coat of paint. Insulated pipes shall first be painted to a smooth, hard surface in the area the label is to be applied. Labels shall be applied, using pressure, so that it lies smooth and flat. After application on insulated pipes, the label shall be stapled securely to the insulation. The labels shall be applied to the pipe so that the lettering is in the most legible position. For overhead piping apply markers on the lower half of the pipe where view is unobstructed, so that markers can be read at a glance from floor level. The wording on the labels shall correspond directly to the wording in the mechanical symbol lists, regardless of whether or not it is standard wording for the designated manufacturer.
 - b) Use an arrow marker with each pipe content marker. The arrow shall always point away from the pipe marker and in the direction of flow, with background color and height the same as content marker. If flow can be in both directions, use two arrow markers.
 - c) Apply pipe marker and arrow marker at each valve, at every point of pipe entry or exit through wall or ceiling, on each riser and branch of tee, and every 20 feet on long continuous lines or at every bay or aisle to show proper identification of pipe content and direction of flow.
 - b. Valves: All main service valves, including fire protection, located inside the building shall be tagged and identified as to the type of service. All valves controlling branch mains or risers to various portions of the building shall be tagged and identified as to the areas served.
 - c. Controls: All automatic controls, control panels, zone valves, pressure electric, electric pressure switches, relays and starters shall be clearly tagged and identified. Wording shall be identical to that on the control diagram in the contract drawings.
 - d. Pumps: All pumps shall be identified as to service with aluminum or brass tags secured by tie wires.
 - E. Concrete Bases: Construct concrete equipment bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000 psi, 28-day compressive strength concrete and reinforcement as specified in Division 3 sections of the Specifications. Housekeeping pads under pumps, etc. shall be 3-1/2 inches thick with #4 reinforcing bars 12 inches on center each way unless otherwise noted.
 - F. Erection of Metal Supports and Anchorage:
 1. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
 2. Field Welding: Comply with AWS D1.1 "Structural Welding Code - Steel."
 - G. Cutting and Patching:

1. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.
2. Repair cut surfaces to match adjacent surfaces.

H. Grouting:

1. Install nonmetallic, nonshrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates and anchors. Mix grout according to manufacturer's printed instructions.
2. Clean surfaces that will come into contact with grout.
3. Provide forms for placement of grout, as required.
4. Avoid air entrapment when placing grout.
5. Place grout, completely filling equipment bases.
6. Place grout on concrete bases to provide a smooth bearing surface for equipment.
7. Place grout around anchors.
8. Cure placed grout according to manufacturer's printed instructions.

END OF SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

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SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze angle valves.
 - 2. Brass ball valves.
 - 3. Bronze ball valves.
 - 4. Bronze lift check valves.
 - 5. Bronze swing check valves.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller.
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. Or equal.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, Bronze Angle Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. NIBCO INC.
 - c. Or equal.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

C. Class 150, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Kitz Corporation.
 - c. Or equal.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

D. Class 150, Bronze Angle Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Or equal.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.3 BRASS BALL VALVES

A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Kitz Corporation.

- b. Or equal.
2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig.
 - c. Body Design: One piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.
- B. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. DynaQuip Controls.
 - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - e. Hammond Valve.
 - f. Jamesbury; a subsidiary of Metso Automation.
 - g. Jomar International, LTD.
 - h. Kitz Corporation.
 - i. Legend Valve.
 - j. Marwin Valve; a division of Richards Industries.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Red-White Valve Corporation.
 - n. RuB Inc.
 - o. Or equal.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
- C. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
- d. Hammond Valve.
- e. Jamesbury; a subsidiary of Metso Automation.
- f. Kitz Corporation.
- g. Marwin Valve; a division of Richards Industries.
- h. Milwaukee Valve Company.
- i. RuB Inc.
- j. Or equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

D. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Hammond Valve.
- b. Jamesbury; a subsidiary of Metso Automation.
- c. Legend Valve.
- d. Marwin Valve; a division of Richards Industries.
- e. Milwaukee Valve Company.
- f. Or equal.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

E. Two-Piece, Regular-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Jamesbury; a subsidiary of Metso Automation.
 - b. Marwin Valve; a division of Richards Industries.
 - c. Or equal.

2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Brass or bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Regular.

2.4 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Or equal.

2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Or equal.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.5 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Or equal.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

B. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Flo Fab Inc.
 - b. Hammond Valve.
 - c. Kitz Corporation.
 - d. Milwaukee Valve Company.
 - e. Mueller Steam Specialty; a division of SPX Corporation.
 - f. NIBCO INC.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - i. Or equal.

2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: NBR, PTFE, or TFE.

2.6 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
 - m. Or equal.

2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - j. Or equal.
2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Zy-Tech Global Industries, Inc.
 - j. Or equal.
2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - g. Or equal.

2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate, or plug valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends or solder-joint valve-end.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends.
 - 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
 - 5. For Steel Piping, NPS 5 and Larger: Flanged ends.
 - 6. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

END OF SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

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

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Fiberglass pipe hangers.
 - 4. Metal framing systems.
 - 5. Fiberglass strut systems.
 - 6. Thermal-hanger shield inserts.
 - 7. Fastener systems.
 - 8. Pipe stands.
 - 9. Equipment supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Fiberglass strut systems.
 - 4. Pipe stands.
 - 5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel stainless steel.
- B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel .

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel stainless steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
2. Hanger Rods: Continuous-thread rod, washer, and nuts made of fiberglass polyurethane or stainless steel.

B. Strap-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.

- h. Or equal.
- 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
- 3. Standard: MFMA-4.
- 4. Channels: Continuous slotted steel channel with inturned lips.
- 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel stainless steel.
- 7. Metallic Coating: Electroplated zinc Hot-dipped galvanized Mill galvanized In-line, hot galvanized Mechanically-deposited zinc.
- 8. Paint Coating: Vinyl Vinyl alkyd Epoxy Polyester Acrylic Amine Alkyd
- 9. Plastic Coating: PVC Polyurethane Epoxy Polyester.
- 10. Combination Coating:

B. Non-MFMA Manufacturer Metal Framing Systems:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation; H-Strut Division.
 - e. NIBCO INC.
 - f. PHD Manufacturing, Inc.
 - g. PHS Industries, Inc.
 - h. Or equal.
- 2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
- 3. Standard: Comply with MFMA-4.
- 4. Channels: Continuous slotted steel channel with inturned lips.
- 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel stainless steel .
- 7. Coating: Zinc Paint PVC.

2.5 FIBERGLASS STRUT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Allied Tube & Conduit.
 - 2. Champion Fiberglass, Inc.
 - 3. Cooper B-Line, Inc.

4. SEASAFE, INC.; a Gibraltar Industries Company.
 5. Or equal.
- B. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.
1. Channels: Continuous slotted fiberglass or other plastic channel with inturned lips.
 2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of fiberglass stainless steel.

2.6 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Carpenter & Paterson, Inc.
 2. Clement Support Services.
 3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
 10. Or equal.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.8 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Plastic Stainless steel.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 2. Bases: One or more; plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.9 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.10 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
 - I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
 - J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
 - K. 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.
 - L. Install lateral bracing with pipe hangers and supports to prevent swaying.
 - M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
 - N. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
 - O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
 - P. Insulated Piping:
 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

- e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
- C. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

- D. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High Performance Coatings."
- E. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and fiberglass pipe hangers and fiberglass strut systems and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Freestanding Restrained Freestanding and restrained spring isolators.
 - 5. Housed spring mounts.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Spring hangers with vertical-limit stops.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.
 - 11. Freestanding Restrained Freestanding and restrained air-mounting system.
 - 12. Restrained vibration isolation roof-curb rails.
 - 13. Seismic snubbers.
 - 14. Restraining braces and cables.
 - 15. Steel Inertia Steel and inertia, vibration isolation equipment bases.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Basic Wind Speed:
 - 2. Building Classification Category: I II III IV.

3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: A B C D E F.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I II III.
 - a. Component Importance Factor: 1.0 1.5
 - b. Component Response Modification Factor: 1.5 2.5 3.5 5.0
 - c. Component Amplification Factor: 1.0 2.5
3. Design Spectral Response Acceleration at Short Periods (0.2 Second): %.
4. Design Spectral Response Acceleration at 1-Second Period: %.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

4. Seismic- and Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.
- E. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional Contracting Officer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
 - 10. Or equal.
- D. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene rubber hermetically sealed compressed fiberglass.
- E. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

- F. Restrained Mounts: All-directional mountings with seismic restraint.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- G. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- H. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- I. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.
- J. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- K. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- L. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- M. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- N. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 AIR-MOUNTING SYSTEMS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
1. California Dynamics Corporation.
 2. Firestone Industrial Products Company.
 3. Kinetics Noise Control.
 4. Mason Industries.
 5. Vibration Eliminator Co., Inc.
 6. Or equal.
- D. Air Mounts: Freestanding, single or multiple, compressed-air bellows.
1. Assembly: Upper and lower steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows.
 2. Maximum Natural Frequency: 3 Hz.
 3. Operating Pressure Range: 25 to 100 psig.
 4. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
 5. Leveling Valves: Minimum of 3 required to maintain leveling within plus or minus 1/8 inch.
- E. Restrained Air Mounts: Housed compressed-air bellows.
1. Assembly: Upper and lower steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows and spring, with angle-iron frame having vertical-limit stops and channel-section top with leveling adjustment and attachment screws.
 2. Maximum Natural Frequency: 3 Hz.
 3. Operating Pressure Range: 25 to 100 psig.
 4. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
 5. Leveling Valves: Minimum of 3 required to maintain leveling within plus or minus 1/8 inch.

2.3 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.
 3. Isolation Technology, Inc.
 4. Kinetics Noise Control.
 5. Mason Industries.
 6. Thybar Corporation.
 7. Vibration Eliminator Co., Inc.
 8. Vibration Isolation.

- 9. Vibration Mountings & Controls, Inc.
 - 10. Or equal.
- C. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.
 - D. Lower Support Assembly: Formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic and wind forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
 - E. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
 - 1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or wind restraint.
 - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 2. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - a. Resilient Material: Oil- and water-resistant standard neoprene natural rubber hermetically sealed compressed fiberglass.
 - F. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
 - G. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

2.4 VIBRATION ISOLATION EQUIPMENT BASES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.
 3. Isolation Technology, Inc.
 4. Kinetics Noise Control.
 5. Mason Industries.
 6. Vibration Eliminator Co., Inc.
 7. Vibration Isolation.
 8. Vibration Mountings & Controls, Inc.
 9. Or equal.
- C. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- D. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.5 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.
 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 4. Hilti, Inc.
 5. Kinetics Noise Control.
 6. Loos & Co.; Cableware Division.
 7. Mason Industries.
 8. TOLCO Incorporated; a brand of NIBCO INC.
 9. Unistrut; Tyco International, Ltd.
 10. Or equal.
- C. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- D. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.
- E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- F. Restraint Cables: ASTM A 603 galvanized ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- G. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections Reinforcing steel angle clamped to hanger rod.
- H. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- K. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with

strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

- L. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.6 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction providing required submittals for component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- I. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: NPS will engage Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with NPS, through Contracting Officer, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Contracting Officer's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four <Insert number> of each type and size of installed anchors and fasteners selected by Contracting Officer.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
 9. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 10. Air-Mounting System Operational Test: Test the compressed-air leveling system.
 11. Test and adjust air-mounting system controls and safeties.
 12. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust air-spring leveling mechanism.
- D. Adjust active height of spring isolators.
- E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Contracting Officer's maintenance personnel to adjust, operate, and maintain air-mounting systems

END OF SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

1.3 INFORMATIONAL SUBMITTALS

- A. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Certified TAB reports: Documentation indicating that Work complies with ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.4 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC.
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
 - 2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.
- B. TAB Specialists Qualifications: Certified by NEBB or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB as a TAB technician.

- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures for balancing the systems.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Duct systems are complete with terminals installed.
 - b. Volume are open and functional.
 - c. Clean filters are installed.
 - d. Fans are operating, free of vibration, and rotating in correct direction.
 - e. Automatic temperature-control systems are operational.
 - f. Windows and doors are installed.
 - g. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."

3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," and Section 230716 "HVAC Equipment Insulation".
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 1. Measure total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses, close to the fan and prior to any outlets, to obtain total airflow.

- c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 - 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 4. Obtain approval from National Park Services (NPS), Construction Manager, and commissioning authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
 - B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
 - 1. Measure airflow of submain and branch ducts.
 - 2. Adjust submain and branch duct volume dampers for specified airflow.
 - 3. Re-measure each submain and branch duct after all have been adjusted.
 - C. Adjust air inlets and outlets for each space to indicated airflows.
 - 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 - 2. Measure inlets and outlets airflow.
 - 3. Adjust each inlet and outlet for specified airflow.
 - 4. Re-measure each inlet and outlet after they have been adjusted.
- 3.6 TOLERANCES
- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 - 1. Supply Fans and Equipment with Fans: Plus or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.7 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
 - 3. Certify validity and accuracy of field data.

- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB specialist.
 - 3. Project name.
 - 4. Project location.
 - 5. Contracting Officer's name and address.
 - 6. Contractor's name and address.
 - 7. Report date.
 - 8. Signature of TAB supervisor who certifies the report.
 - 9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 10. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 11. Nomenclature sheets for each item of equipment.
 - 12. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 13. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 14. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.

- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Cooling-coil static-pressure differential in inches wg.
 - g. Outdoor airflow in cfm.
 - h. Outdoor-air damper position.
 - i. Vortex damper position.

F. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.

- g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Motor Data:
- a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.

G. Air-Terminal-Device Reports:

1. Unit Data:
- a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary airflow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final airflow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.

H. Instrument Calibration Reports:

1. Report Data:
- a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.8 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of NPS, Construction Manager, and commissioning authority.
- B. Commissioning authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Contracting Officer may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
 - 3. If the second verification also fails, NPS, design professional, or Contracting Officer may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

3.9 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

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SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corporation
 - b. Johns Manville
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens Corning
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corporation
 - b. Johns Manville
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens Corning

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Eagle Bridges – Marathon Industries
 - c. Foster Brand; H. B. Fuller Construction Products
 - d. Mon-Eco Industries Inc.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Eagle Bridges – Marathon Industries
 - c. Foster Brand; H. B. Fuller Construction Products
 - d. Mon-Eco Industries Inc.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Foster Brand; H. B. Fuller Construction Products
 - c. Knauf Insulation
 - d. Vimasco Corporation
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Eagle Bridges – Marathon Industries
 - c. Foster Brand; H. B. Fuller Construction Products
 - d. Knauf Insulation
 - e. Mon-Eco Industries, Inc.
 - f. Vimasco Corporation
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand; H. B. Fuller Construction Products
 - b. Eagle Bridges – Marathon Industries
 - c. Foster Brand; H. B. Fuller Construction Products
 - d. Mon-Eco Industries, Inc.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

2.5 FACTORY-APPLIED JACKETS

- ### A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 FIELD-APPLIED JACKETS

- ### A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- ### B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.7 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division
 - b. Compac Corporation
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - d. Knauf Insulation
 - e. Venture Tape
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division
 - b. Compac Corporation
 - c. Ideal Tape Co., Inc., an American Biltrite Company
 - d. Knauf Insulation
 - e. Venture Tape
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.8 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal .

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

- a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low-carbon steel or Aluminum or Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - b. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low-carbon steel or Aluminum or Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive-backed base with a peel-off protective cover.
 4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel or aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
 5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. Retain subparagraph and list of manufacturers below. See Section 016000 "Product Requirements."
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.9 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

- K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.

- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

- b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
 - 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 - 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 - 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
- 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 75 percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.5 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

3.6 FINISHES

A. Do not field paint aluminum or stainless-steel jackets.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Contracting Officer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket or board, 1-1/2 inches thick and 3-lb/cu. ft. nominal density.
- B. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket or board, 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

3.10 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket or board, 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

3.11 OUTDOOR DUCT INSULATION SCHEDULE

- A. Exposed, Rectangular Supply-Air Duct and Insulation: Mineral-fiber board, 2" exterior board wrap (total assembly has an R-8 insulated value per 2018 IECC) with aluminum jacketing.
 1. Aluminum Jacketing shall be:
 - a. Aluminum, stucco embossed with laminated vapor barrier and waterproofing membrane.
 - b. Finish shall be flat finish.
 - c. Color of exposed jacketing shall be per contracting officer.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
 1. FSK Jacket.

END OF SECTION 23 07 13 - DUCT INSULATION

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 - 1. Condensate drain piping, indoors and outdoors.
 - 2. Refrigerant suction and hot-gas piping, indoors and outdoors.
 - 3. Dual-service heating and cooling piping, indoors and outdoors.
 - 4. Heat-recovery piping, indoors and outdoors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.
 - 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 - 2. Sheet Form Insulation Materials: 12 inches square.
 - 3. Jacket Materials for Pipe: 12 inches long by NPS 2.
 - 4. Sheet Jacket Materials: 12 inches square.
 - 5. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Contracting Officer. Use materials indicated for the completed Work.
 - 1. Piping Mockups:
 - a. One 10-foot section of NPS 2 straight pipe.
 - b. One each of a 90-degree threaded, welded, and flanged elbow.
 - c. One each of a threaded, welded, and flanged tee fitting.
 - d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
 - e. Four support hangers including hanger shield and insert.
 - f. One threaded strainer and one flanged strainer with removable portion of insulation.
 - g. One threaded reducer and one welded reducer.
 - h. One pressure temperature tap.
 - i. One mechanical coupling.
 - 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
 - 3. Notify Contracting Officer seven days in advance of dates and times when mockups will be constructed.
 - 4. Obtain Contracting Officer's approval of mockups before starting insulation application.

5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Contracting Officer specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Industrial Insulation Group (IIG); Thermo-12 Gold.
 - b. Or equal.
 - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Foamglas.
 - b. Or equal.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 6. Preformed Pipe Insulation with Factory-Applied ASJ ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
 - d. Or equal.

- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I II with factory-applied vinyl jacket III with factory-applied FSK jacket III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
 - f. Or equal.
- J. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - f. Or equal.
 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, without factory-applied jacket with factory-applied ASJ with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, without factory-applied jacket with factory-applied ASJ with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- K. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory-applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Knauf Insulation; Permawick Pipe Insulation.
 - b. Owens Corning; VaporWick Pipe Insulation.
 - c. Or equal.

- L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
 - f. Or equal.
- M. Phenolic:
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Kingspan Tarec Industrial Insulation NV; Koolphen K.
 - b. Resolco International BV; Insul-phen.
 - c. Or equal.
 2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
 3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
 4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: None ASJ.
- N. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Trymer 2000 XP.
 - b. Duna USA Inc.; Corafoam.
 - c. Dyplast Products; ISO-25.
 - d. Elliott Company of Indianapolis; Elfoam.
 - e. Or equal.
 2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
 3. Flame-spread index shall be 25 or less, and smoke-developed index shall be 50 or less for thickness up to 1 inch as tested by ASTM E 84.

4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
 5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Pipe Applications: None ASJ ASJ-SSL PVDC PVDC-SSL.
- O. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
 - c. Or equal.
- P. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Styrofoam.
 - b. Or equal.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ramco Insulation, Inc.; Super-Stik.
 - b. Or equal.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ramco Insulation, Inc.; Thermokote V.
 - b. Or equal.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.
- b. Or equal.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
 - b. Eagle Bridges - Marathon Industries; 290.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
 - d. Mon-Eco Industries, Inc.; 22-30.
 - e. Vimasco Corporation; 760.
 - f. Or equal.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
 - b. Or equal.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Phenolic and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33.
 - c. Or equal.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - e. Or equal.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - e. Or equal.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- G. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60.
 - c. Or equal.
- H. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - e. Or equal.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- I. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 - e. Or equal.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - c. Or equal.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges - Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.
 - e. Or equal.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 3. Service Temperature Range: 0 to 180 deg F.
 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - Marathon Industries; 570.

- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 - d. Or equal.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
- 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 - f. Or equal.
 - 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: 60 percent by volume and 66 percent by weight.
 - 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
- 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 - d. Or equal.
 - 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 - 4. Service Temperature Range: 0 to plus 180 deg F.
 - 5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Or equal.
2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-70.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Or equal.
3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F.
6. Color: White or gray.
7. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
8. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Or equal.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Or equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
 5. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - 2) Or equal.
6. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
- a. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - 2) Or equal.
7. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
- a. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - 2) Or equal.
8. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas Number 10.
 - b. Or equal.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.
 - c. Or equal.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.
 - b. Or equal.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - e. Or equal.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: White Color-code jackets based on system. Color as selected by Contracting Officer.
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Metal Jacket:
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 - d. Or equal.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper 3-mil- thick, heat-bonded polyethylene and kraft paper 2.5-mil-thick polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper 2.5-mil- thick polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Sheet and roll stock ready for shop or field sizing Factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper 3-mil- thick, heat-bonded polyethylene and kraft paper 2.5-mil-thick polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper 2.5-mil- thick polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

- E. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard Products, Inc.; Insulrap No Torch 125.
 - c. Or equal.

- F. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white stucco-embossed aluminum-foil facing.
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Polyguard Products, Inc.; Alumaguard 60.
 - b. Or equal.

- G. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film.
 - b. Or equal.

- H. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 560 Vapor Retarder Film.
 - b. Or equal.

- I. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 - b. Or equal.

2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

- a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - e. Or equal.
2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - e. Or equal.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 - d. Or equal.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 - e. Or equal.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
 - b. Or equal.
2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.
 - b. Or equal.
2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

- a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
 - c. Or equal.
- 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
 - 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
 - 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
 - C. Wire: 0.080-inch nickel-copper alloy 0.062-inch soft-annealed, stainless steel 0.062-inch soft-annealed, galvanized steel.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets,

- valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.7 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.10 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.11 INSTALLATION OF POLYISOCYANURATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3- and 9-o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of polyisocyanurate insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.12 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.13 INSTALLATION OF POLYSTYRENE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3- and 9-o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, and make thickness same as adjacent pipe insulation, not to exceed 1-1/2-inch.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed section of polystyrene insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.14 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.

4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.15 FINISHES

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Contracting Officer. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.16 FIELD QUALITY CONTROL

- A. Testing Agency: NPS will engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Contracting Officer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.17 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.18 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - d. Phenolic: 1 inch thick.
 - e. Polyisocyanurate: 1 inch thick.
 - f. Polyolefin: 1 inch thick.
- B. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - d. Phenolic: 1 inch thick.
 - e. Polyisocyanurate: 1 inch thick.
 - f. Polyolefin: 1 inch thick.
- C. Refrigerant Suction and Hot-Gas Flexible Tubing:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Polyolefin: 1 inch thick.
- D. Dual-Service Heating and Cooling, 40 to 200 Deg F:
 - 1. NPS 12 and Smaller: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches 2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I: 1 inch 1-1/2 inches 2 inches thick.
 - c. Phenolic: 1 inch 1-1/2 inches 2 inches 3 inches thick.
 - d. Polyisocyanurate: 1 inch thick.
- E. Heat-Recovery Piping:

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I or Pipe and Tank Insulation: 1 inch thick.
 - d. Phenolic: 1 inch thick.
 - e. Polyisocyanurate: 1 inch thick.
 - f. Polyolefin: 1 inch thick.

3.19 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Flexible Elastomeric: 2 inches thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 - d. Phenolic: 2 inches thick.
 - e. Polyisocyanurate: 2 inches thick.
 - f. Polyolefin: 2 inches thick.
 - g. Polystyrene: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 2 inches thick.
 - b. Polyolefin: 2 inches thick.

C. Heat-Recovery Piping:

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Flexible Elastomeric: 2 inches thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 - d. Phenolic: 2 inches thick.
 - e. Polyisocyanurate: 2 inches thick.
 - f. Polyolefin: 2 inches thick.
 - g. Polystyrene: 2 inches thick.

D. Dual-Service Heating and Cooling:

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 3 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 - c. Phenolic: 2 inches thick.
 - d. Polyisocyanurate: 2 inches thick.

3.20 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Loose-fill insulation, for belowground piping, is specified in Section 232113.13 "Underground Hydronic Piping" and Section 336313 "Underground Steam and Condensate Distribution Piping."
- B. Chilled Water, All Sizes: Cellular glass, 2 inches thick.
- C. Dual-Service Heating and Cooling, All Sizes, 40 to 200 Deg F: Cellular glass, 3 inches thick.

3.21 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. None.
 - 2. PVC, Color-Coded by System: 20 mils thick.
 - 3. Aluminum, Smooth Corrugated Stucco Embossed: 0.024 inch thick.
- D. Piping, Exposed:
 - 1. None.
 - 2. PVC, Color-Coded by System: 20 mils thick.
 - 3. Aluminum, Smooth Corrugated Stucco Embossed: 0.024 inch thick.

3.22 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. None.
 - 2. PVC, Color-Coded by System: 30 mils thick.
 - 3. Aluminum, Smooth Corrugated Stucco Embossed: 0.024 inch thick.
- D. Piping, Exposed:
 - 1. PVC: 40 mils thick.
 - 2. Painted Aluminum, Smooth Corrugated Stucco Embossed with Z-Shaped Locking Seam: 0.024 thick.

3.23 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 23 07 19 - HVAC PIPING INSULATION

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SECTION 23 08 00 – COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents:

1. Drawings and general provisions of the Subcontract apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:

1. General requirements that apply to implementation of commissioning of HVAC systems, assemblies and components.

C. Related Sections:

1. Division 01 Section "General Requirements."
2. Division 01 Section "Total Building Commissioning"
3. Division 23 HVAC Sections.

1.2 REFERENCES

A. General:

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.
4. Refer to Division 23 Section "Common Results for HVAC" for codes and standards, and other general requirements.

1.3 DESCRIPTION

- A. The purpose of commission is to ensure the University that work has been completed as specified and that systems are functioning in the manner as described in Division 23 Section "Common Results for HVAC" and specified system operating criteria. It will assist operating staff training and familiarization with new systems. It will serve as a tool to reduce post-occupancy critical systems operational difficulty or failure. It will, also, be used to develop test protocol and record the associated test data in an effort to advance the building systems from a state of substantial completion to a full dynamic operation.
- B. Commission will commence after preliminary punch list items are completed by Subcontractors.
- C. The steps associated with commissioning are outlined below:
 1. Step One - Installation Verification
 2. Step Two - System Start-Up.
 3. Step Three – Functional Performance Testing.
- D. Operational staff training is essential to the commission process and will run concurrently with steps one through three.

- E. The Commissioning Team will include representatives of the University, Construction and Installing Subcontractors, Test and Balance Subcontractor, FMCS Subcontractor and Construction Subcontractor's Commissioning Agent. Equipment manufacturer's representatives will be present for start-up as specified in the equipment specification sections and for equipment training.

1.4 SYSTEMS TO BE COMMISSIONED

- A. Commissioning will be performed on the following systems:
 - 1. Main Building Ventilation
 - 2. Main Building Conditioning
 - 3. Kiosk Ventilation
 - 4. Kiosk Conditioning
 - 5. Freeze Protection

1.5 SUBMITTALS

- A. Submit under provisions of Division 23 Section "Common Results for HVAC - Review of Materials" and Division 01 Section "General Requirements."
- B. Commissioning Plan as prepared by the prime Subcontractor or his Commissioning Agent.
- C. Prime subcontractors or his Commissioning Agent shall provide Functional Performance Tests (FPT) procedures for the above listed systems. Prime subcontractors or his Commissioning Agent shall provide system narrative descriptions as part of the FPT procedures.

PART 2 - PRODUCTS

2.1 COMMISSIONING PLAN

- A. The commissioning plan shall outline the organization, scheduling, team members, and documentation pertaining to the overall commissioning process.

2.2 NARRATIVE DESCRIPTIONS

- A. A narrative description of the design intents of the systems and their intended modes of sequences of operation.

2.3 FUNCTIONAL PERFORMANCE TESTS (FPT) PROCEDURES

- A. The FPT procedures at the minimum shall consist of the following sections:
 - 1. Narrative Description:
 - a. This section provides a narrative description of the design intents of the systems and their intended modes of sequences of operation.
 - 2. Testing Prerequisites:
 - a. This section contains verification that primary mechanical, electrical, and controls systems that support or interact with the system that the FPT is prepared against are completed, tested and operational.
 - 3. Installation Verification:
 - a. This section contains verification that the system installation is completed and is ready for commissioning.

4. Commencement of Functional Performance Testing:
 - a. This section records the date and time of the start of system commissioning.
5. System Condition Prior to Starting Performance Testing:
 - a. This section records the current set points and parameters of the system at the start of commissioning.
6. Functional Performance Test:
 - a. This section shall provide the following:
 - 1) Sequential steps required to set parameters and conditions required to test component and functions throughout intended ranges of operation.
 - 2) Full range of checks and tests carried out to determine if electric and pneumatic connections, components, subsystems, systems and interfaces between systems function in accordance with the contract documents and design intents.
 - 3) All modes and sequences of control operations, interlocks and conditional control responses and specified responses to abnormal emergency conditions.
7. End of Functional Performance Test:
 - a. This section records the date and time of the end of system commissioning.
8. Field Notes:
 - a. This section records notes or remarks during system commissioning.
9. List systems modifications, not required by the Contract Documents, but provided by the Subcontractor. List other questions regarding such system modifications.
10. List problems discovered during Commissioning that were corrected.
11. List problems discovered during Commissioning that were not corrected.
12. List recommended party that should take action on these problems.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Subcontractors shall be responsible for performing procedures presented in specification and contract drawings as detailed in the Functional Performance Tests (FPT). Members of the designated Commissioning Team shall witness various portions of the commissioning process. Responsibilities for these activities are listed in the following paragraphs. Commissioning Team members shall sign-off on appropriate sections after verifying installation, operation, or documentation. Final sign-off shall be by the University and Commissioning Agent.
- B. Any test ports, gauges, test equipment, etc., needed to accomplish the functional performance tests shall be provided by Subcontractors.
- C. Subcontractors shall provide to the Commissioning Team documentation of calibration of controls. Documentation shall include dates, setpoints, calibration coefficients, control loop verification, and other data required to verify system check-out. Documentation shall be dated and initialed by field engineer or technician performing the work.

3.2 OPERATIONAL STAFF TRAINING

- A. System narrative descriptions will be prepared by the Commission Agent and supported by flow diagrams, one line diagrams, and appropriate specification sections for major systems to be commissioned. The Commission Agent will coordinate "system description" meetings with

members of facility management and maintenance department groups to review system description documentation. The meetings will provide an overview of major system features, components, and arrangements.

- B. The Subcontractor and associated manufacturer's representatives shall provide required training to operational staff after the system description meetings have occurred. The Subcontractor training sessions shall provide a more detailed analogy of systems operation and maintenance.

3.3 INSTRUMENTATION

- A. Instrumentation will be provided by the Subcontractor. Instruments used for measurements shall be accurate. Calibration histories for each instrument shall be available for examination. Calibration and maintenance of instruments shall be in accordance with the requirements of NEBB or AABC Standards.
- B. Application of instruments and accuracy of measurements shall be in accordance with NEBB or AABC Standards.

3.4 DOCUMENTATION

- A. The installing Subcontractor shall be responsible for collection of pertinent data during system start-up and functional performance testing. The Subcontractor shall submit to the Commissioning Agent documentation of tests performed prior to and after system start-up. Documentation shall also include start-up procedures as approved by Commissioning Team.
- B. Documentation is to be typewritten on 8-1/2 by 11 inches (200 by 280 mm) paper and inserted in a 2 inches (50 mm) to 3 inches (75 mm) thick three ring binder. Indicate the project name, number, volume number, and volume title on the end panel of each binder.
- C. Provide a title sheet for each volume and list the following:
 - 1. Volume Title and Section Name and Number requiring this submittal.
 - 2. Project name, project number, and address.
 - 3. Subcontractor name, address, and phone number.
 - 4. Name, title, signature, and date of person making the submittal.
 - 5. Name of University, a blank line for signature, and the date of person accepting the submittal.
 - 6. Name, address, and phone number of Commission Agent; a blank line for signature; and date of person accepting the submittal.
- D. Provide a Table of Contents for multiple submittals. List each submittal and page number. Number each page, centered on the bottom in sequential numerical order. Provide tabs for multiple submittals in a single binder.

3.5 STEP ONE - INSTALLATION VERIFICATION

- A. General Commissioning responsibilities:
 - 1. Before system start-up begins, the Commission Team shall conduct a final installation verification audit. The Subcontractor shall be responsible for completion of work including change orders and punch list items to the University's satisfaction. The audit shall include, but not be limited to, checking of:
 - a. Piping specialties including balance, control, and isolation valves.
 - b. Ductwork specialty items including turning devices, balance, fire, smoke, control dampers, and access doors.
 - c. Control sensor types and location.
 - d. Identification of piping, valves, equipment, controls, etc.
 - e. Major equipment, pumps, valves, starters, gauges, thermometers, etc.
 - f. Documentation of prestart-up tests performed, including manufacturer's factory tests.

2. If work is found to be incomplete, incorrect, or non-functional, the Subcontractor shall correct the deficiency before system start-up work proceeds.

3.6 STEP TWO - SYSTEM START-UP

A. General Commissioning Responsibilities:

1. A start-up plan shall be developed and submitted by the installing Subcontractor. Start-up plan to include the following:
 - a. Flushing and cleaning of pipe.
 - b. Filters, strainers, and screens.
 - c. Valve/damper positions.
 - d. Electrical tests.
 - e. Pressure tests.
 - f. Safeties.
 - g. Chemical treatment.
 - h. Manufacturer's tests.
2. The start-up plan will be reviewed and a prestart-up inspection performed by designated members of the Commissioning Team. The installing Subcontractor shall commence with system start-up after approval has been given to start-up plan and the prestart-up inspection is completed. Designated members of the Commissioning Team shall witness system start-up and list system and equipment deficiencies noted during start-up. The Subcontractor shall take corrective action on system deficiencies noted and demonstrate to the Commissioning Team members suitable system operation.
3. Designated systems requiring test and balance work shall have this activity commence after systems have successfully completed start-up. System and equipment deficiencies observed during this activity is to be noted and corrected.

3.7 STEP THREE - FUNCTIONAL PERFORMANCE TESTING

A. General Commissioning Responsibilities:

1. Functional Performance Testing begins after operational testing, adjusting, and balancing of the systems have been completed by the Subcontractors; and the System Description and Hands-on Training sessions have been completed.
2. The objective of the Functional Performance Testing is to advance the building systems from a state of substantial completion to full dynamic operation in accordance with the specified design requirements and design intent.
3. Attaining this object will be accomplished by developing individual systems testing protocols which, when implemented by the Subcontractor, will allow the Commissioning Team to observe, evaluate, identify deficiencies, recommend modifications, tune, and document the systems and systems equipment performance over a range of load and functional levels.
4. Functional Performance tests for the systems to be commissioned are defined in the Commissioning Plan. These tests are intended to be conclusive but may require minor modifications as system operation dictates.

END OF SECTION 23 08 00

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SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Refrigerant pipes and fittings.
 - 2. Refrigerant piping valves and specialties.
 - 3. Refrigerants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of valve, refrigerant piping, and refrigerant piping specialty.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.

2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, or L.

- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8/A5.8M.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
 - 4. Working Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 deg F.
- G. Copper Pressure-Seal Fitting for Refrigerant Piping:
 - 1. Standard: UL 207; certified by UL for field installation. Certification as a UL-recognized component alone is unacceptable.
 - 2. Housing: Copper.
 - 3. O-Rings: HNBR or compatible with specific refrigerant.
 - 4. Tools: Manufacturer's approved special tools.
 - 5. Minimum Rated Pressure: 700 psig.

2.3 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 - 3. Operator: Rising stem and hand wheel.
 - 4. Seat: Nylon.
 - 5. End Connections: Socket, union, or flanged.
 - 6. Working Pressure Rating: 500 psig.
 - 7. Maximum Operating Temperature: 275 deg F.
- B. Packed-Angle Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze.
 - 2. Packing: Molded stem, back seating, and replaceable under pressure.
 - 3. Operator: Rising stem.
 - 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 - 5. Seal Cap: Forged-brass or valox hex cap.
 - 6. End Connections: Socket, union, threaded, or flanged.
 - 7. Working Pressure Rating: 500 psig.

8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.

F. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

H. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

I. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in parts per million (ppm).
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

2.4 REFRIGERANTS

ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Hot-Gas and Liquid Lines: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- B. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- C. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

- D. 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.
- E. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
 - 1. Compressor.
- F. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- G. Install receivers sized to accommodate pump-down charge.
- H. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. 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.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Install refrigerant piping in protective conduit where installed belowground.
- L. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- M. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 2. Install horizontal suction lines with a uniform slope downward to compressor.
 3. Install traps and double risers to entrain oil in vertical runs.
 4. Liquid lines may be installed level.
- N. When brazing or soldering, 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.
- O. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- P. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
 2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic restraints in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- D. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within 12 inches of each fitting.
- F. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. 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. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall 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.
- B. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.

4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves except bypass valves that are used for other purposes.
 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 23 23 00 - REFRIGERANT PIPING

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" or ASCE/SEI 7.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ANSI/ASHRAE 62.1.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.

9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Ductmate Industries, Inc.
 - b. Elgen Manufacturing.
 - c. Linx Industries (formerly Lindab).
 - d. McGill AirFlow LLC.
 - e. MKT Metal Manufacturing.
 - f. SEMCO LLC.
 - g. Sheet Metal Connectors, Inc.
 - h. Spiral Manufacturing Co., Inc.
 - i. Stamped Fittings Inc.
 - j. Or equal
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 1. Galvanized Coating Designation: G90.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: 4 inches.
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. 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.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. 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.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths.

- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- B. Seal ducts at a minimum to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 2. Outdoor, Supply-Air Ducts: Seal Class A.
 3. Outdoor, Exhaust Ducts: Seal Class C.
 4. Outdoor, Return-Air Ducts: Seal Class C.
 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "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.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. 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.
- F. 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.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. 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. 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.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. 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. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.7 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

- B. Supply Ducts:

1. Ducts Connected to Furnaces:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.

- C. Return Ducts:

1. Ducts Connected to Furnaces:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.

- D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 12
 - d. SMACNA Leakage Class for Round and Flat Oval: 12
- F. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
 2. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Galvanized or Match duct material.
 3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.
- G. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13 - METAL DUCTS

SECTION 23 31 16 - NONMETAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fibrous-glass ducts and fittings.
 - 2. Phenolic-foam ducts and fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Fibrous-glass duct materials.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
- C. Delegated-Design Submittal: For nonmetal ducts, signed and sealed by a qualified professional

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Seismic Qualification Data: Certificates, for nonmetal ducts, accessories, and components, from manufacturer.
- C. Welding certificates.
- D. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Hanger and Support Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for steel hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum hangers and supports.

- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including duct closure, reinforcements, and hangers and supports, shall comply with the following and with the Works' performance requirements and design criteria:
 - 1. SMACNA's "Fibrous Glass Duct Construction Standards."
 - 2. Static-Pressure Classes:
 - a. Supply Ducts (except in Mechanical Rooms): 2-inch wg.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions to comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1, Section 5.4 - "Airstream Surfaces."
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- F. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

2.2 FIBROUS-GLASS DUCTS AND FITTINGS

- A. Fibrous-Glass Duct Materials: Resin-bonded fiberglass, faced on the outside surface with fire-resistant FSK vapor retarder and with a smooth fiberglass mat finish on the air-side surface.
 - 1. Duct Board: Factory molded into rectangular boards.
 - 2. Temperature Limits: 40 to 250 deg inside ducts; 150 deg F ambient temperature surrounding ducts.
 - 3. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F) mean temperature.
 - 4. Moisture Absorption: Not exceeding 5 percent by weight at 120 deg F and 95 percent relative humidity for 96 hours when tested according to ASTM C1104/C1104M.

5. Acoustical Performance: Conform to sound absorption coefficients listed in NAIMA AH116.
6. Permeability: 0.02 perms maximum when tested according to ASTM E96/E96M, Procedure A.
7. Antimicrobial Agent: Compound shall be tested for efficacy by an NRTL, and registered by the EPA for use in HVAC systems.
8. Noise-Reduction Coefficient: 0.65 minimum when tested according to ASTM C423, Mounting A.
9. Fire/Smoke Resistance: Duct material shall comply with UL 181, Class 1, maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL according to ASTM E84.
10. Required Markings: EI stiffness rating, UL label, and other markings required by UL 181 on each full sheet of duct board.

B. Closure Materials:

1. Pressure-Sensitive Tape: Comply with UL 181A; imprinted by manufacturer with coding "181A-P," manufacturer's name, and a date code.
 - a. Tape: Aluminum foil-scrim tape imprinted with listing information.
 - b. Minimum Tape Width: 2-1/2 inches ; 3 inches for duct board thicker than 1 inch.
 - c. Staples: 1/2-inch outward clinching, 2 inches o.c. in tabs, one tab per joint.
 - d. Water resistant.
 - e. Mold and mildew resistant.
2. Heat-Activated Tape: Comply with UL 181A; imprinted by manufacturer with coding "181A-H," manufacturer's name, and a date code.
 - a. Tape: Aluminum foil-scrim tape imprinted with listing information.
 - b. Minimum Tape Width: 3 inches.
 - c. Heat-Sensitive Imprint: Printed indicator on tape to show proper heating during application has been achieved.
 - d. Water resistant.
 - e. Mold and mildew resistant.
3. Two-Part Tape Sealing System: Comply with UL 181A; imprinted by manufacturer with coding "181A-M," manufacturer's name, and a date code.
 - a. Tape: Woven glass fiber impregnated with mineral gypsum.
 - b. Minimum Tape Width: 3 inches.
 - c. Sealant: Modified styrene acrylic.
 - d. Water resistant.
 - e. Mold and mildew resistant.
4. Wet Lay-Up Method:
 - a. Follow manufacturer's instructions for installation.
 - b. Material: Unsaturated polyester resin in monomer.
 - c. Water resistant.
 - d. Mold and mildew resistant.

C. Fabrication:

1. Comply with: SMACNA's "Fibrous Glass Duct Construction Standards," Ch. 3, "Specifications and Closure," and Ch. 4, "Fittings and Connections" for the following:

- a. Joints, seams, transitions, elbows, and branch connections.
 - b. Reinforcements, including channel and tie rod reinforcement materials, spacing, and fabrications.
2. Fabricate 90-degree mitered elbows to include turning vanes.
- D. Reinforcements: Comply with requirements in SMACNA's "Fibrous Glass Duct Construction Standards," Ch. 5, "Reinforcement" for channel- and tie-rod reinforcement materials, spacing, and fabrication.
- E. Structural Loading: Provide product with H-20 Loading rating.

2.3 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Zinc-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 , "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables: ASTM A603, galvanized-steel cables with end connections made of zinc-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports: Steel shapes complying with ASTM A36/A36M.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. 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.
- B. Install duct sections in maximum practical lengths with fewest possible joints.
- C. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- D. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

- E. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- F. Install ducts with a minimum clearance of 1 inch plus allowance for insulation thickness.
- G. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- H. Where ducts pass through non-fire-rated interior partitions and exterior walls, and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges. Overlap openings on four sides by at least 1-1/2 inches.
- I. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- J. Elbows: Use long-radius elbows wherever they fit.
 - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes, and 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
- K. Branch Connections: Use lateral or conical branch connections.
- L. Install fibrous-glass ducts and fittings to comply with SMACNA's "Fibrous Glass Duct Construction Standards."
- M. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.2 HANGER AND SUPPORT INSTALLATION

- A. Install hangers and supports for fibrous-glass ducts and fittings to comply with SMACNA's "Fibrous Glass Duct Construction Standards," Ch. 6, "Hangers and Supports"
- B. Install hangers and supports for phenolic-foam ducts and fittings to comply with SMACNA's "Phenolic Duct Construction Standards" Ch. 6, "Hangers and Supports" and with manufacturer's written instructions.
- C. 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.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Contracting Officer will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Perform tests and inspections

D. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Where static pressure and leakage values shown below differ from those in the SMACNA manual, the more stringent values shall apply.
3. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Contracting Officer from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - b. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Contracting Officer from sections installed totaling no less than 25 percent of total installed duct area for each designated pressure class.
4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

E. Duct System Cleanliness Tests:

1. Test protocols shall be performed according to NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems," "Section 5 - Cleanliness Verification and Documentation."
2. Visually inspect duct system to ensure that no visible contaminants are present.
3. Test sections of fibrous-glass duct system chosen randomly by Contracting Officer for cleanliness according to "Method 2 Protocol."
4. Test sections of Phenolic-foam duct systems chosen randomly by Contracting Officer, for cleanliness according to "Method 3 - NADCA Vacuum Test."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

F. Duct system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.4 DUCT CLEANING

A. Clean duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch

duct as recommended by duct manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.

2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. 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. 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.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. All duct cleaning shall be performed according to NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
2. 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. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of ducts or duct accessories.
4. Clean fibrous-glass duct with HEPA vacuuming equipment; do not permit duct to get wet. Replace fibrous-glass duct that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for washdown procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removing surface deposits and debris.

3.5 DUCT SCHEDULE

A. Outdoor Underground Ducts and Fittings:

1. Fibrous-Glass Round Ducts and Fittings:
 - a. Minimum Flexural Rigidity: EI-800.
 - b. Minimum Board Thickness: 2 inches.
 - c. Material: Monoxivent 824 Resin with R-10 insulation for UnderDuct Double-Wall.
 - d. Joint Sealant Material: Unsaturated polyester resin, glass-resin.

END OF SECTION 23 31 16 - NONMETAL DUCTS

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Backdraft and pressure relief dampers.
 - 2. Manual volume dampers.
 - 3. Control dampers.
 - 4. Flange connectors.
 - 5. Turning vanes.
 - 6. Flexible connectors.
 - 7. Duct accessory hardware.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.

- B. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Description: Gravity balanced.
- B. Maximum Air Velocity: 1000 fpm.
- C. Maximum System Pressure: 0.5-inch wg.
- D. Frame: Hat-shaped, 0.05-inch-thick, galvanized sheet steel.
- E. Blades: Multiple single-piece blades, end pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.
- F. Blade Action: Parallel.
- G. Blade Seals: Neoprene, mechanically locked.
- H. Blade Axles:
 1. Material: Galvanized steel or Aluminum.
 2. Diameter: 0.20 inch.
- I. Tie Bars and Brackets: Aluminum or Galvanized steel.
- J. Return Spring: Adjustable tension.
- K. Bearings: Steel ball.
- L. Accessories:
 1. Adjustment device to permit setting for varying differential static pressure.
 2. Screen Mounting: Rear mounted.
 3. Screen Material: Galvanized steel or Aluminum.
 4. Screen Type: Insect.
 5. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Standard leakage rating, with linkage outside airstream.
2. Suitable for horizontal or vertical applications.
3. Frames:
 - a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
5. Blade Axles: Galvanized steel.
6. Bearings:
 - a. Molded synthetic or Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
7. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Standard leakage rating, with linkage outside airstream.
2. Suitable for horizontal or vertical applications.
3. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
5. Blade Axles: Galvanized steel.
6. Bearings:
 - a. Molded synthetic or Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
7. Tie Bars and Brackets: Galvanized steel.

C. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.5 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

2.6 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Set dampers to fully open position before testing, adjusting, and balancing.

- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install access doors with swing against duct static pressure.
- G. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- H. Install flexible connectors to connect ducts to equipment.
- I. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 33 00 - AIR DUCT ACCESSORIES

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SECTION 23 74 33 - DEDICATED OUTDOOR-AIR UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes factory-packaged units capable of supplying up to 100 percent outdoor air and providing cooling and heating.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, and attachment details.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Compressors: Five years from date of Substantial Completion.
 - 2. Warranty Period for Unit: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."
- B. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Capacities and Characteristics:
 - 1. Supply Airflow: See mechanical schedule.
 - 2. External Static Pressure: See mechanical schedule.
 - 3. Supply Fan:
 - a. Size: See mechanical schedule.
 - b. Speed: See mechanical schedule.

- c. Brake Horsepower: See mechanical schedule.
- 4. Supply Fan Motor:
 - a. Size: See mechanical schedule.
 - b. Speed: See mechanical schedule. Volts: See mechanical schedule.
 - c. Phase: See mechanical schedule.
 - d. Hertz: 60.
- 5. Gas-Fired Furnace Heating:
 - a. Heat-Transfer Rate: See mechanical schedule.
 - b. Entering-Air Temperature: See mechanical schedule.
 - c. Leaving-Air Temperature: See mechanical schedule.
 - d. Efficiency: Minimum of 80percent.
 - e. Fuel: Propane gas.
- 6. Gas Heating Value: See mechanical schedule. Gas Input: See mechanical schedule. Overall Unit Electrical Characteristics:
 - a. Volts: See mechanical schedule.
 - b. Phase: See mechanical schedule.
 - c. Hertz: 60.
 - d. Full-Load Amperes: See mechanical schedule.
 - e. Minimum Circuit Ampacity: See mechanical schedule.
 - f. Maximum Overcurrent Protection: See mechanical schedule.

2.2 CABINET

- A. Construction: double wall.
- B. Exterior Casing Material: Galvanized steel with paint finish
- C. Interior Casing Material: Galvanized.
- D. Lifting and Handling Provisions: Factory-installed shipping skids and lifting lugs.
- E. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
 - 1. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.
- F. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.
- G. Cabinet Insulation:
 - 1. Type: Fibrous-glass duct lining complying with ASTM C1071, Type II
 - 2. Thickness: 1 inch.
 - 3. Insulation Adhesive: Comply with ASTM C916, Type I.

4. Mechanical Fasteners: Suitable for adhesive, mechanical, or welding attachment to casing without damaging liner and without causing air leakage when applied as recommended by manufacturer.

H. Condensate Drain Pans:

1. Shape: Rectangular, with 2 percent slope in at least two planes to direct water toward drain connection.
2. Size: Large enough to collect condensate from cooling coils including coil piping connections, coil headers, and return bends.
 - a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1
 - b. Depth: A minimum of 2 inches deep.
3. Configuration: Single wall.
4. Material: Galvanized-steel sheet with asphaltic waterproofing compound coating on pan top surface.
5. Drain Connection:
 - a. Located on one end of pan, at lowest point of pan.
 - b. Terminated with threaded nipple.
 - c. Minimum Connection Size: NPS 1.
6. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

- I. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1 for resistance to mold and erosion.

2.3 SUPPLY FAN

- A. Forward-Curved Fan Type: Centrifugal; statically and dynamically balanced.
1. Fan Wheel Material: Galvanized steel, mounted on solid-steel shaft.
 2. Bearings: Self-aligning, permanently lubricated ball bearings
- B. Service Factor for Belt Drive Applications: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly with minimum 1.5 service factor.
- C. Mounting: Fan wheel, motor, and drives shall be mounted to fan casing with spring isolators.

2.4 DIRECT-FIRED GAS FURNACE HEATING

A. Furnace Assembly:

1. Factory assembled, piped, and wired.
2. Comply with requirements in NFPA 54, "National Fuel Gas Code," and ANSI Z21.47, "Gas-Fired Central Furnaces."
3. AGA Approval: Designed and certified by and bearing label of AGA.

B. Burners:

1. Fuel: Propane gas.
 2. Ignition: Electronically controlled electric spark with flame sensor.
 3. High-Altitude Kit: For Project elevations more than 2000 feet above sea level.
- C. Heat-Exchanger Drain Pan Material: Stainless steel.
- D. Venting: Gravity vented.
- E. Venting: Power vent with integral, motorized centrifugal fan interlocked with gas valve.
- F. Safety Controls:
1. Gas Control Valve: Two stage.
 2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.5 OUTDOOR-AIR INTAKE HOOD

- A. Type: Manufacturer's standard hood or louver.
- B. Materials: Match cabinet.
- C. Bird Screen: Comply with requirements in ASHRAE 62.1.
- D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.6 FILTERS

- A. Disposable Panel Filters:
 1. Comply with NFPA 90A.
 2. Factory-fabricated, viscous-coated, flat-panel type.
 3. Thickness: 2 inches.
 4. Minimum MERV: 8, according to ASHRAE 52.2.
 5. Media: Interlaced glass fibers sprayed with nonflammable adhesive.

2.7 ELECTRICAL POWER CONNECTIONS

- A. General Electrical Power Connection Requirements: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.
- B. Enclosure: NEMA 250, Type 3R, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key,
- C. Wiring: Numbered and color-coded to match wiring diagram.
- D. Wiring Location: Install factory wiring outside an enclosure in a raceway.

- E. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:
 - 1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - 2. NEMA KS 1, heavy-duty, nonfusible switch.
 - 3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- F. Factory-Mounted, Overcurrent-Protection Service: For each motor.
- G. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
- H. Controls: Factory wire unit-mounted controls where indicated.
- I. Lights: Factory wire unit-mounted lights.
- J. Receptacle: Factory wire unit-mounted, ground fault interrupt (GFI) duplex receptacle.
- K. Control Relays: Auxiliary and adjustable time-delay relays.
- L. Control Dampers:
 - 1. Damper Location: Factory installed inside unit for ease of blade axle and bushing service. Arrange dampers located in a mixing box to achieve convergent airflow to minimize stratification.
 - 2. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. at a static-pressure differential of 4.0 inches water column when a torque of 5 in./lb per sq. ft. is applied to the damper jackshaft.
 - 3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
 - 4. Damper Label: Bear the AMCA seal for both air leakage and performance.
 - 5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control and equipment isolation service and use modulating control when mixing two airstreams. For other applications, use an opposed-blade configuration.
 - 6. Damper Frame Material: galvanized steel.
 - 7. Blade Type: Single-thickness metal reinforced with multiple V-grooves
 - 8. Blade Material: galvanized steel
 - 9. Maximum Blade Width: 6 inches
 - 10. Maximum Blade Length: 48 inches
 - 11. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless-steel compression-type seals.
 - 12. Bearings: Thrust bearings for vertical blade axles.
 - 13. Airflow Measurement:
 - a. Monitoring System: Complete and functioning system of airflow monitoring as an integral part of the damper assembly where indicated.
 - b. Remote Monitoring Signal: 0-10 volt or 4-20 mA scaled signal.
 - c. Accuracy of flow measurement: Within 10 percent of the actual flow rate between the range of the scheduled minimum and maximum airflow. For units with a large range between minimum and maximum airflow, configure the damper sections and flow measurement assembly as necessary to comply with accuracy.

- d. Straightening Device: Integral to the flow measurement assembly if required to achieve the specified accuracy as installed.
- e. Flow measuring device: Suitable for operation in untreated and unfiltered outdoor air. If necessary, include temperature and altitude compensation and correction to maintain the accuracy.

M. Damper Operators:

- 1. Factory-installed electric operator for each damper assembly with one operator for each damper assembly mounted to the damper frame.
- 2. Operator capable of shutoff against fan pressure and able to operate the damper with sufficient reserve power to achieve smooth modulating action and proper speed of response at the velocity and pressure conditions to which the damper is subjected.
- 3. Maximum Operating Time: Open or close damper 90 degrees in 90 seconds.
- 4. Adjustable Stops: For both maximum and minimum positions.
- 5. Position Indicator and Graduated Scale: Factory installed on each actuator with words "OPEN" and "CLOSED," or similar identification, at travel limits.
- 6. Spring-return operator to fail-safe; either closed or open as required by application.
- 7. Operator Type: Direct coupled, designed for minimum 60,000 full-stroke cycles at rated torque.
- 8. Position feedback Signal: For remote monitoring of damper position.
- 9. Coupling: V-bolt and V-shaped, toothed cradle.
- 10. Circuitry: Electronic overload or digital rotation-sensing circuitry.

N. Furnace Controls:

- 1. Factory-mounted sensor in supply outlet with sensor adjustment located in control panel to modulate gas furnace burner to maintain space temperature.
- 2. Wall-mounted, space-temperature sensor with temperature adjustment to modulate gas furnace burner to maintain space temperature.
- 3. Staged Burner Control: Two.
- 4. Electromechanical or Electronic Burner Control: 20 to 100 percent modulation of the firing rate; 10 to 100 percent with dual-furnace units.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.
- B. Curb Support: Install grade-mounted curb on grade structure according to manufacturer's recommendations.
 - 1. Install and secure units on curbs and coordinate grade penetrations.
- C. Equipment Mounting:

1. Install air units on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- D. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.
- E. Comply with requirements for gas-fired furnace installation in NFPA 54, "National Fuel Gas Code."
- F. Install separate devices furnished by manufacturer and not factory installed.
- G. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- H. Install drain pipes from unit drain pans.
1. Drain Piping: Drawn-temper copper water tubing complying with ASTM B88, Type L with soldered joints.
 2. Drain Piping: Schedule 40 PVC pipe complying with ASTM D1785, with solvent-welded fittings.
 3. Pipe Size: Same size as condensate drain pan connection.

3.2 CONNECTIONS

- A. Where installing piping adjacent to units, allow space for service and maintenance.
- B. Gas Piping Connections:
1. Comply with requirements in Section 231126 "Facility Liquefied-Petroleum Gas Piping."]
 2. Connect gas piping to furnace, full size of gas train inlet, and connect with union, pressure regulator, and shutoff valve with sufficient clearance for burner removal and service.
 3. Install AGA-approved flexible connectors.
- C. Duct Connections:
1. Comply with requirements in Section 233113 "Metal Ducts."
 2. Drawings indicate the general arrangement of ducts.
 3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."
- D. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.

1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform orPerform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Inspect units for visible damage to furnace combustion chamber.
 3. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:
 - a. Measure gas pressure at manifold.
 - b. Measure combustion-air temperature at inlet to combustion chamber.
 - c. Measure flue-gas temperature at furnace discharge.
 - d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
 4. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. High-limit heat exchanger.
 - b. Alarms.
 5. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
 6. Inspect casing insulation for integrity, moisture content, and adhesion.
 7. Verify that clearances have been provided for servicing.
 8. Verify that controls are connected and operable.
 9. Verify that filters are installed.
 10. Clean coils and inspect for construction debris.
 11. Clean furnace flue and inspect for construction debris.
 12. Inspect operation of power vents.
 13. Purge gas line.
 14. Inspect and adjust vibration isolators and seismic restraints.
 15. Verify bearing lubrication.
 16. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 17. Adjust fan belts to proper alignment and tension.
 18. Start unit.
 19. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
 20. Operate unit for run-in period.
 21. Calibrate controls.
 22. Adjust and inspect high-temperature limits.
 23. Inspect outdoor-air dampers for proper stroke].
 24. Verify operational sequence of controls.
 25. Measure and record the following airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Outdoor-air flow.

- B. After startup, change filters, verify bearing lubrication, and adjust belt tension.
- C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.
- D. Prepare written report of the results of startup services.

3.4 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 23 74 33 - DEDICATED OUTDOOR-AIR UNITS

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SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.5 WARRANTY

- A. 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. Warranty Period:
 - a. For Compressor: One year from date of Substantial Completion.
 - b. For Parts: One year from date of Substantial Completion.
 - c. For Labor: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INDOOR UNITS (5 TONS OR LESS)

A. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Contracting Officer, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Fan: Direct drive, centrifugal.
4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Enclosure Type: Totally enclosed, fan cooled.
 - d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
 - f. Mount unit-mounted disconnect switches on exterior of unit.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Condensate Drain Pans:
 - a. Integral to the equipment with a minimum of one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Depth: A minimum of 1 inch deep.
 - b. Single-wall, galvanized-steel sheet.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 3/4.
 - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
7. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum MERV according to ASHRAE 52.2.
 - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

2.2 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Contracting Officer, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant: R-410A.
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Mounting Base: Polyethylene.

2.3 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- B. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
 1. Compressor time delay.
 2. 24-hour time control of system stop and start.
 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 4. Fan-speed selection including auto setting.
- C. Automatic-reset timer to prevent rapid cycling of compressor.
- D. 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.
- E. Drain Hose: For condensate.
- F. Outdoor Unit:
 1. Type: Air cooled.
 2. Electrical Characteristics:
 - a. Volts: 208.
 - b. Phase: Single.
 - c. Frequency: 60 Hz.
 - d. Minimum Circuit Ampacity: See mechanical schedule.

- e. Maximum Overcurrent Protection: See mechanical schedule.
- f. Fan Motor Full-Load Amperes: See mechanical schedule.
- g. Compressor Full-Load Amperes: See mechanical schedule.
- h. Compressor Locked-Rotor Amperes: See mechanical schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
 - 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
 - 3. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 4. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

END OF SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS

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SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Applicable codes include the following:
 - 1. International Building Code 2021
 - 2. ASHRAE 90.1-2016
 - 3. International Fire Code 2021
 - 4. National Electric Code 2020
 - 5. NPS Building Standards

1.2 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Common electrical installation requirements.

1.3 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. To connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.

- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items, except as otherwise indicated in drawings.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Exposed raceways/conduit: Where conduit or raceway is routed in an exposed location, the conduit and raceway shall be painted to match adjacent finishes. Coordinate required finishes with Contracting Officer.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. 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.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Alcan Products Corporation; Alcan Cable Division.
 2. American Insulated Wire Corp.; a Leviton Company.
 3. General Cable Corporation.
 4. Senator Wire & Cable Company.
 5. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THWN-2 or XHHW-2.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN-THWN-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN-2, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

D. Exposed Branch Circuits, Including in Crawlspace: Type THWN-2, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN-2, single conductors in raceway. Metal-clad cable, Type MC is not allowed.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

H. Class 1 Control Circuits: Type THHN-THWN-2, in raceway.

- I. Class 2 Control Circuits: Type THHN-THWN-2, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.
- D. Provide crimped ferrules for stranded wires at any screw terminal locations.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Grounding arrangements and connections for separately derived systems.
- C. Field quality-control test reports.

1.3 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.4 QUALITY ASSURANCE

- A. 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.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.

3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad; 5/8" in diameter by 96 inches in length.

2.4 GROUNDING BUSBARS

- A. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000V.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
 2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
1. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 2. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- F. Ground Rod: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
- G. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 FT of bare copper conductor not smaller than No. 4, AWG.
 - 1. If concrete pad is less than 20 FT long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
 - 3. Stub up in an accessible location with wire long enough to reach the expected final landing at the service entrance without splicing. Shall be marked and protected until such time that the work on the Ufer ground is completed.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements listed below.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rod. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- B. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less; 10 ohms.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.

- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Steel slotted channel systems. Include Product Data for components.
 - 2. Nonmetallic slotted channel systems. Include Product Data for components.
 - 3. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 5. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 3. Fitting and Accessory Materials: Same as channels and angles.
 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
- 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
- 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
- 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
- 6. Toggle Bolts: All-steel springhead type.
- 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.

- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.
- F. RSC: Rigid steel conduit

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 QUALITY ASSURANCE

- A. 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.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
 2. Alflex Inc.
 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 5. Electri-Flex Co.
 6. Manhattan/CDT/Cole-Flex.
 7. Maverick Tube Corporation.
 8. O-Z Gedney; a unit of General Signal.
 9. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Aluminum Rigid Conduit: ANSI C80.5.
- D. IMC: ANSI C80.6.
- E. PVC-Coated Steel Conduit: PVC-coated Rigid Steel Conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- F. EMT: ANSI C80.3.
- G. LFMC: Flexible steel conduit with PVC jacket.
- H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 2. Fittings for EMT: Steel, set-screw type.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 3. Arnco Corporation.
 4. CANTEX Inc.
 5. CertainTeed Corp.; Pipe & Plastics Group.
 6. Condux International, Inc.
 7. ElecSYS, Inc.
 8. Electri-Flex Co.
 9. Lamson & Sessions; Carlon Electrical Products.
 10. Manhattan/CDT/Cole-Flex.
 11. RACO; a Hubbell Company.
 12. Thomas & Betts Corporation.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated. Type EPC-80-PVC for areas that will be subjected to vehicular travel.
- C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by the Contracting Officer.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 2. EGS/Appleton Electric.
 3. Erickson Electrical Equipment Company.
 4. Hoffman.
 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 6. O-Z/Gedney; a unit of General Signal.
 7. RACO; a Hubbell Company.
 8. Robroy Industries, Inc.; Enclosure Division.
 9. Scott Fetzer Co.; Adalet Division.
 10. Spring City Electrical Manufacturing Company.
 11. Thomas & Betts Corporation.
 12. Walker Systems, Inc.; Wiremold Company (The).
 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- E. Metal Floor Boxes: Cast or sheet metal, semi-adjustable, rectangular.
- F. Nonmetallic Floor Boxes: Nonadjustable, round.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic.
- J. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77, TIER 15.
 - 1. Color of Frame and Cover: Gray.
 - 2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, "ELECTRIC." or "TELEPHONE." depending upon the cabling the box is enclosing.
 - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 7. Handholes and boxes are to be fiberglass with Polymer-Concrete Fram and Cover. Sheet-molded fiberglass-reinforced polyester-resin enclosure joined to polymer-concrete top ring or frame.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit.
 2. Concealed Conduit, Aboveground: EMT.
 3. Underground Conduit: For horizontal underground conduit, utilize RNC, Type EPC-80-PVC, direct buried. Underground bends are to utilize PVC Coated Rigid Steel prefabricated sections. Vertical underground conduit (risers) shall be PVC Coated Rigid Steel.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed, Subject to Severe Physical Damage: RSC.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: IMC. (This includes all basement areas.)
 7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 3R, stainless steel in damp or wet locations (which includes all basement areas).
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- G. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- K. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- L. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).
 - 1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

- a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - d. Attics: 135 deg F (75 deg C) temperature change.
2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- M. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC in damp or wet locations not subject to severe physical damage.
- N. Set metal floor boxes level and flush with finished floor surface.
- O. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- P. Install plastic bushings at conduit terminations prior to pulling wire.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as indicated in drawings for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as indicated in drawings.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as indicated in drawings.
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured PVC coated rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

- a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install handholes and boxes with bottom below the frost line, 30" below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Presealed Systems.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors [2 inches (50 mm)] above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Underground-line warning tape.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
 - 2. Legend: Indicate system or service and voltage, if applicable.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- C. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- (0.35-mm-) thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.
- D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking nylon tie fastener.
- E. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.
4. Inscriptions for Blue-Colored Tapes: CONTROL CIRCUIT CABLE.

C. Tape Characteristics:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, compounded for direct-burial service.
2. Overall Thickness: 5 mils (0.125 mm).
3. Foil Core Thickness: 0.35 mil (0.00889 mm).
4. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
5. 3-Inch (75-mm) Tensile According to ASTM D 882: 70 lbf (311.3 N), and 4600 psi (31.7 MPa).

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).

- E. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).
- B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- C. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- D. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength: 50 lb (22.6 kg), minimum.
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 09 painting Sections.
1. Interior Gypsum Board:
 - a. Semigloss Acrylic-Enamel Finish: One finish coat over a primer.
 - 1) Primer: Interior gypsum board primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.

2. Interior Ferrous Metal:
 - a. Semigloss Acrylic-Enamel Finish: One finish coat over a primer.
 - 1) Primer: Interior ferrous-metal primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
 3. Interior Zinc-Coated Metal (except Raceways):
 - a. Semigloss Acrylic-Enamel Finish: One finish coat over a primer.
 - 1) Primer: Interior zinc-coated metal primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
- C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:
1. Fire Alarm System: Red.
 2. Fire-Suppression Supervisory and Control System: Red and yellow.
 3. Combined Fire Alarm and Security System: Red and blue.
 4. Security System: Blue and yellow.
 5. Mechanical and Electrical Supervisory System: Green and blue.
 6. Telecommunication System: Green and yellow.
 7. Control Wiring: Green and red.
- B. Power-Circuit Conductor Identification: For secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.
- D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- G. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Adhesive film label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Disconnect switches.
 - c. Enclosed circuit breakers.
- H. Arc Flash Hazard warning label: Refer to Specification 26 05 73 section 3.5(B) for labeling requirements associated with the Arc Flash Hazard Analysis study.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- G. Color-Coding for Phase Identification, 600 V and Less: Use the colors listed below for ungrounded branch-circuit conductors.
 - 1. Color shall be factory applied.
 - 2. Colors for 240/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - 3. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

END OF SECTION 26 05 53

SECTION 26 05 73 - ELECTRICAL SYSTEM STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes computer-based, fault-current, overcurrent protective device coordination, and arc flash hazard analysis studies. Protective devices shall be set based on results of the protective device coordination study.

1.3 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- C. Qualification Data: For coordination-study specialist.
- D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.

1.4 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer and Contracting Officer.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

- D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:
 - 1. CGI CYME
 - 2. EDSA Micro Corporation
 - 3. ESA Inc.
 - 4. Operation Technology, Inc.
 - 5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device

- settings.
2. Impedance of utility service entrance.
 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Utility transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - e. Busway ampacity and impedance.
 - f. Motor horsepower and code letter designation according to NEMA MG 1.
 4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - c. Ratings, types, and settings of utility company's overcurrent protective devices.
 - d. Special overcurrent protective device settings or types stipulated by utility company.
 - e. Time-current-characteristic curves of devices indicated to be coordinated.
 - f. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - g. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 1. Service disconnects.
 2. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 and IEEE 242.

1. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
2. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 141 and IEEE 242 recommendations for fault currents and time intervals.

C. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

D. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists

between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

- a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. No damage, melting, and clearing curves for fuses.
 - d. Cable damage curves.
 - e. Maximum fault-current cutoff point.
- E. Completed data sheets for setting of overcurrent protective devices.

3.5 ARC FLASH HAZARD ANALYSIS STUDY

- A. Furnish an Arc Flash Hazard Analysis Study for the entire electrical system. Analysis shall be inclusive of individual disconnecting devices (not light switches or receptacles) per the requirements set forth in NFPA 70E – Standard for Electrical Safety in the workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E.
1. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
 2. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt system where work could be performed on energized parts.
 3. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
 4. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model.
 5. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating.
 6. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:
 - a. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 - b. Fault contribution from synchronous motors should be decayed to match the actual decrement of each as closely as possible.

7. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
8. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
9. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
10. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

B. Based on the results of the Arc Flash Hazard Analysis study, produce and install a warning label (orange ≤ 40 cal/cm²) or danger label (red > 40 cal/cm²) per NFPA 70 & 70E for each piece of equipment as specified above in accordance with ANSI Z535. The label must be readable in both indoor and outdoor environments for at least 3 years and contain the following information:

1. Arc hazard boundary (inches).
2. Working distance (inches)
3. Arc flash incident energy at the working distance (calories/cm²).
4. PPE category and description including the glove rating.
5. Voltage rating of the equipment.
6. Limited approach distance (inches).
7. Restricted approach distance (inches).
8. Prohibited approach distance (inches).
9. Equipment/bus name.
10. Date prepared.
11. Supplier name and address.

END OF SECTION 26 05 73

SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes Cx process requirements for the following electrical components, systems, assemblies, and equipment:

- 1. Electrical equipment connected to Normal power systems, including the following:
 - a. Distribution and branch-circuit panelboards.
 - b. Luminaires
 - c. Lighting Controls
 - d. Fire Alarm System
 - e. Communication System
 - f. Grounding System

- B. Related Requirements:

- 1. Section 019114 "Total Building Commissioning" for general Cx process requirements and CxA responsibilities.

1.3 DEFINITIONS

- A. BoD: Basis-of-Design Document, as defined in Section 019114 "Total Building Commissioning"
- B. Cx: Commissioning, as defined in Section 019114 "Total Building Commissioning"
- C. CxA: Commissioning Authority, as defined in Section 019114 "Total Building Commissioning"
- D. Low Voltage: 600 V and below.
- E. Normal Power Systems: A power system that provides primary power to a facility.
- F. OPR: Owner's Project Requirements, as defined in Section 019114 "Total Building Commissioning"
- G. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

- A. Construction Checklists: Draft construction checklists will be created by CxA for Contractor review.
- B. Construction Checklists: Include the following and comply with requirements in Section 019114 "Total Building Commissioning" for construction checklists:
 - 1. Panelboards.
 - 2. Luminaires.
 - 3. Lighting Controls
 - 4. Fire Alarm
 - 5. Communications

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electrical systems and components to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Testing Technician Qualifications: Technicians to perform electrical Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
 - 1. Journey level or equivalent skill level. Vocational school four-year-program graduate or an Associate's degree in electrical systems, or similar field. Degree may be offset by three years' experience as an apprentice or a journey-level electrician. Generally, required knowledge includes electrical and HVAC&R concepts, building operations, and application and use of tools and instrumentation to measure performance of electrical equipment, assemblies, and systems.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONSTRUCTION CHECKLISTS

- A. Provided by CxA, completed by contractor.

3.2 CONSTRUCTION CHECKLIST REVIEW

- A. Review and provide written comments on draft construction checklists. CxA will create required draft construction checklists and provide them to Contractor.
- B. Return draft Construction Checklist review comments within **[10]** days of receipt.

- C. When review comments have been resolved, CxA will provide final construction checklists, marked "Approved for Use, (date)."
- D. Use only construction checklists, marked "Approved for Use, (date)."

3.3 GENERAL TESTING REQUIREMENTS

- A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating according to the Contract Documents and approved Shop Drawings and submittals.
- B. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to Contracting Officer. After deficiencies are resolved, reschedule tests.

3.4 Cx TESTS FOR ELECTRICAL SYSTEMS

- A. Verification of Power System Operation:
 - 1. Prerequisites: Acceptance of results for construction checklists for Division 26 electrical components associated with Normal power system.
 - 2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
 - 3. Test Purpose: Verify operation of power system.
 - 4. Test Conditions: Energize components of Normal power system, one at a time. Equipment and Systems to Be Tested: Division 26 electrical equipment.
- B. Acceptance Criteria: Operation of equipment according to OPR.

3.5 Cx TESTS FOR LUMINAIRES.

- A. Verification of Luminaires:
 - 1. Prerequisites: Acceptance of results for construction checklists for Division 26 Luminaires.
 - 2. Equipment and Systems to Be Tested: Division 26 Luminaires.
 - 3. Test Purpose: Verify operation of Luminaires.
 - 4. Test Conditions: Energize components of Luminaires.
- B. Acceptance Criteria: Operation of equipment according to OPR.

3.6 Cx TESTS FOR LIGHTING CONTROLS.

- A. Verification of Lighting Controls:
 - 1. Prerequisites: Acceptance of results for construction checklists for Division 26 Lighting Controls.

2. Equipment and Systems to Be Tested: Division 26 Lighting Controls.
3. Test Purpose: Verify operation of Lighting Controls.
4. Test Conditions: Energize components of Lighting Controls.

B. Acceptance Criteria: Operation of equipment according to OPR.

3.7 Cx TESTS FOR FIRE ALARM SYSTEM.

A. Verification of Fire Alarm System:

1. Prerequisites: Acceptance of results for construction checklists for Division 26 Digital Addressable Fire-Alarm System.
2. Equipment and Systems to Be Tested: Division 28 Fire Alarm System.
3. Purpose: Verify operation of Fire Alarm System.
4. Test Conditions: Energize components of Fire Alarm System.

B. Acceptance Criteria: Operation of equipment according to OPR.

3.8 Cx TESTS FOR COMMUNICATIONS.

A. Verification of Communications:

1. Prerequisites: Acceptance of results for construction checklists for Division 27 Communications System.
2. Equipment and Systems to Be Tested: Division 27 Communications System.
3. Purpose: Verify operation of Communications to comply with cabling warranty requirements.
4. Test Conditions: Energize components of Communications System.

B. Acceptance Criteria: Operation of equipment according to OPR.

3.9 Cx TESTS FOR GROUNDING SYSTEM

A. Verification of Grounding and Bonding:

1. Prerequisites: Acceptance of results for construction checklists for Division 26 Grounding and Bonding.
2. Equipment and Systems to Be Tested: Division 26 Grounding and Bonding.
3. Purpose: Verify operation of grounding systems to comply with grounding warranty requirements.
4. Test Conditions: Energize components grounding system.

B. Acceptance Criteria: Operation of equipment according to OPR.

END OF SECTION 26 08 00

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Indoor occupancy sensors.
- B. Related Sections include the following:
 - 1. Division 26 Section "Wiring Devices" for manual light switches.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. 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.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hubbell Lighting.
2. Watt Stopper (The).
3. Greengate
4. nLight

- B. General Description: Wall mounted, 120v units which do not require a separate low voltage power pack.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 60 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
4. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
5. Bypass Switch: Override the on function in case of sensor failure.
6. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.
7. Auxiliary Contacts: Where mechanical equipment is indicated for occupancy sensor control, auxiliary contact shall have a minimum horsepower rating suitable for the connected equipment, to be verified with final mechanical shop drawings.

- C. Dual-Technology Type: Wall/ceiling mounted; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm),

and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

- A. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- B. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to one visit to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Park's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
- C. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- D. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panelboards for installation according to NECA 407.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations:
1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: 10 deg F to plus 140 deg F.

b. Altitude: 8,200 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude: 8,200 feet.

1.9 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

1.11 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Keys: Two spares for each type of panelboard cabinet lock.
 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Quantity as indicated on electrical drawings.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344.
- B. Enclosures: Flush- and surface-mounted cabinets.
1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

- b. Other Wet or Damp Indoor Locations: NEMA 250, Type 3R.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 - 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 6. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Full capacity separate ground bus for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 3. Neutral Bus: Neutral bus rated 100 percent of phase bus and UL listed as suitable for nonlinear loads.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or lugs only.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- G. Branch Overcurrent Protective Devices: Fused switches.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Match panelboard manufacturer.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger. Used for all breakers unless otherwise noted.
 - 2. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip). Refer to plans for GFI breaker locations.
 - 3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
 - g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407.

- B. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to panelboards.
 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Mount top of trim [90 inches (2286 mm)] above finished floor unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
1. Set field-adjustable, circuit-breaker trip ranges.
- G. Install filler plates in unused spaces.
- H. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- J. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 27 13 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes equipment for electricity metering by National Park Service, Demand Metering.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Describe electrical characteristics, features, and operating sequences, both automatic and manual. Include the following:
 - 1. Electricity-metering equipment.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For electricity-metering equipment to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Receive, store, and handle modular meter center as specified in NECA 400.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
- B. Meter Sockets: Comply with requirements of electrical power utility company.

2.3 EQUIPMENT FOR ELECTRICITY DEMAND METERING

A. Available Manufacturers:

1. E-MON L.P.
2. National Meter Industries, Inc.
3. Osaki Meter Sales, Inc.
4. Power Measurement.
5. Square D; Schneider Electric.

B. Kilowatt-Hour/Demand Meter: Electronic single- and three-phase meters, measuring electricity use and demand.

1. Basis of design product, E-MON Green Class, or approved equal.
2. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
3. Display: Digital liquid crystal, indicating accumulative kilowatt hours, current time and date, current demand, historic peak demand, and time and date of historic peak demand.
4. Programmable Contact Module: Unit shall have push-button switches and a display for setting the demand level at which an integral set of Form C contacts shall be operated to initiate indicated action.
5. Enclosure: NEMA 250, Type 1 minimum, with hasp for padlocking or sealing.
6. Identification: Comply with Division 26 Section "Identification for Electrical Systems."
7. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
8. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for ratings of circuits indicated for this application.
 - a. Type: Solid core.
9. Meter Accuracy: Nationally recognized testing laboratory certified to comply with ANSI C12.1.
10. Meet the requirements of EPACT 2005.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install equipment for utility company metering. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Install modular meter center according to NECA 400 switchboard installation requirements.

3.2 FIELD QUALITY CONTROL

- A. Test electricity-metering installation for proper operation, accuracy, and usability of output data.
 - 1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
 - 2. Turn off circuits supplied by metered feeder and secure them in off condition.
 - 3. Run test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use test load placement and setting that ensures continuous, safe operation.
 - 4. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at test load connection. Record test results.
 - 5. Repair or replace deficient or malfunctioning metering equipment, or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

END OF SECTION 26 27 13

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Toggle switches.
- B. Related Sections include the following:
 - 1. Division 26 Section "Lighting Control Devices" for wall-switch occupancy sensors.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. 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.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Government-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.4 GFCI RECEPTACLES

- A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Exterior Locations: Provide with in-use cover. Device shall be corrosion resistant, suitable for salt air conditions.
- C. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper.
 - b. Hubbell.
 - c. Leviton.
 - d. Pass & Seymour.

2.5 SPECIAL EQUIPMENT RECEPTACLES

- A. General Description: Voltage and NEMA configuration as indicated on drawings: Comply with NEMA WD 1, NEMA WD 6, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper.
 - b. Hubbell.
 - c. Leviton.
 - d. Pass & Seymour.

2.6 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Single Pole:
 - a) Cooper; AH1221.
 - b) Hubbell; HBL1221.
 - c) Leviton; 1221-2.
 - d) Pass & Seymour; CSB20AC1.
 - 2) Two Pole:
 - a) Cooper; AH1222.
 - b) Hubbell; HBL1222.

- c) Leviton; 1222-2.
- d) Pass & Seymour; CSB20AC2.

2.7 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Thermoplastic.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.8 FINISHES

- A. Color: Wiring Device outlet colors are to be white for locations with steel or thermoplastic cover plates. Confirm with Contracting Officer prior to providing submittals.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:

- a. Replace all existing conductors.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw. Pressure plate connections are also acceptable. Stab in connections are not allowed.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation: Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 INSPECTION

A. Contractor will perform inspection of sub-contractor work immediately after work in this section is completed.

B. Contractor will record observations for conformance with ABAAS and SDC Accessibility Standards using the DSC, CQC Accessibility Inspection Report.

1. Report may be supplemented by sketches, notation, digital images, product literature, red-line contract documents, etc. to illustrate and explain conditions.

C. Coordinate inspections according to updated construction schedules.

D. Submit report to Contracting Officer within 24 hours of commencing inspection.

END OF SECTION 26 27 26

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers.
 - 4. Molded-case switches.
 - 5. Enclosures.

1.3 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.
 - 4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. Include the following items at a minimum:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

A. 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.

B. Comply with NFPA 70.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: 8,200 Feet

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

B. Fusible Switch, 600A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 600A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Moeller Electric Corporation.
4. Siemens Energy & Automation, Inc.
5. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

C. Molded-Case Circuit-Breaker Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- E. Molded-Case Switch Accessories:
1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
 2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage. Provide "dummy" trip unit where required for proper operation.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Other Wet or Damp Indoor Locations: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 26 28 16

SECTION 26 41 13 – LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes lightning protection for buildings.

1.3 DEFINITIONS

- A. LPI: Lightning Protection Institute.
- B. NRTL: National recognized testing laboratory.

1.4 SUBMITTALS

- A. Product Data: For air terminals and mounting accessories.
- B. Shop Drawings: Detail lightning protection system, including air-terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.
- C. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include data on listing or certification by an NRTL or LPI.
- D. Certification, signed by Contractor, that roof adhesive for air terminals is approved by manufacturers of both the terminal assembly and the single-ply membrane roofing material.
- E. Field inspection reports indicating compliance with specified requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who is an NRTL or who is certified by LPI as a Master Installer/Designer.
- B. Listing and Labeling: As defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

- A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.
- B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Automatic Lightning Protection.
 - 2. ERICO International Corporation.
 - 3. Harger Lightning Protection, Inc.
 - 4. Heary Bros. Lightning Protection Co. Inc.
 - 5. Independent Protection Co.
 - 6. Robbins Lightning Inc.
 - 7. Thompson Lightning Protection, Inc.

2.2 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. Comply with UL 96.
- B. Roof-Mounting Air Terminals: NFPA Class I, copper, unless otherwise indicated.
 - 1. Single-Membrane, Roof-Mounting Air Terminals: Designed for single-membrane roof materials.
- C. Stack-Mounting Air Terminals: Solid copper.
- D. Ground Rods and Ground Loop Conductors: Comply with Division 26 Section "Grounding and Bonding for Electrical Systems" and with standards referenced in this Section.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A and NFPA 780.
- B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops.
- C. Conceal the following conductors, except as otherwise noted.

1. System conductors.
 2. Down conductors.
 3. Interior conductors.
 4. Conductors within normal view from exterior locations at grade within 200 feet (60 m) of building.
 5. Notify Contracting Officer at least 48 hours in advance of inspection before concealing lightning protection components.
- D. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components, except those above single-ply membrane roofing.
- E. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.
- F. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.
- G. A counterpoise installation based on requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" may be used as a ground loop required by NFPA 780, provided counterpoise conductor meets or exceeds minimum requirements in NFPA 780.
1. Bond ground terminals to counterpoise conductor.
 2. Bond grounded metal bodies on building within 12 feet (3.6 m) of ground to counterpoise conductor.
 3. Bond grounded metal bodies on building within 12 feet (3.6 m) of roof to counterpoise conductor.
- H. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot (18-m) intervals.

3.2 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.3 FIELD QUALITY CONTROL

- A. UL Inspection: Provide inspections as required to obtain a UL Master Label for system.
- B. Provide an inspection by an inspector certified by LPI to obtain an LPI certification.

END OF SECTION 26 41 13

SECTION 26 43 13 - TRANSIENT VOLTAGE SUPPRESSION (SURGE PROTECTION) FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.3 DEFINITIONS

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Comply with UL 1449.
- D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE SUPPRESSOR

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advanced Protection Technologies Inc. (APT).
 - 2. Current Technology
 - 3. Eaton Corporation.
 - 4. Emerson Electric Co.
 - 5. GE Zenith Controls.
 - 6. PowerLogics, Inc.
 - 7. Schneider Electric Industries SAS.
 - 8. Siemens Industry, Inc.
- B. SPDs: Comply with UL 1449, Type 1, listed as a Type 1 device, suitable for use in a Type 1 or 2 installation.
 - 1. SPDs with the following features and accessories:
 - a. Internal thermal protection that disconnects the SPD before damaging internal

- suppressor components.
 - b. Indicator light display for protection status.
 - c. Surge counter.
- C. Comply with UL 1283.
- D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- E. Protection modes and UL 1449 VPR for grounded wye circuits with 240/120 V, single-phase, three-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V for 240/120 V.
 - 2. Line to Ground: 1200 V for 240/120 V.
 - 3. Line to Line: 1000 V for 240/120 V.
- F. SCCR: Equal or exceed 100 kA.
- G. Inominal Rating: 20 kA.

2.3 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.

2.4 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Wiring:
 - 1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical

Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
 - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
 - 2. Inspect anchorage, alignment, grounding, and clearances.
 - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION 26 43 13

SECTION 26 51 00 - LIGHTING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

- B. Related Sections include the following:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

- A. CRI: Color-rendering index.
- B. LER: Luminaire efficacy rating.
- C. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 1. Physical description of lighting fixture including dimensions.
 2. Emergency lighting units including battery and charger.
 3. Driver.
 4. Energy-efficiency data.
 5. Life, output, and energy-efficiency data for lamps.
 6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

- a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
 - b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
1. Wiring Diagrams: Power wiring.
- C. Qualification Data: For agencies providing photometric data for lighting fixtures.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- F. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- B. 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.
- C. Comply with NFPA 70.

1.6 COORDINATION

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
1. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product, not limited to manufacturers specified. Shop drawings for equivalent fixtures are to be provided for review and approval 7 days prior to bid.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- D. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- E. Plastic Diffusers and Covers:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
 - 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

- f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.4 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.5 SOLID STATE LIGHTING FIXTURES

A. Housing, where applicable:

1. Steel bonderized or equal rust projected, or aluminum, rigid construction. Minimum gauge thickness shall be as follows:
 - a. Interior locations: No. 20 gauge steel, no. 16 gauge aluminum.

B. Finish:

1. Baked enamel finish (except when otherwise specified).
2. Concealed interior surfaces (this applies to interior hardware, circuit boards, etc.) matte black.
3. Concealed exterior surfaces: matte black.
4. Visible surfaces: color and texture as specified below for each fixture type or as selected.
5. Exterior fixture finish: refer to Lighting Fixture Schedule.

C. Light Emitting Diode (LED) requirements:

1. Correlated color temperature (CCT) for phosphor - coated white LEDs must have one of the following designated CCT's and fall within the following binning standards:
 - a. Outdoor:
 - i. 2700K defined as 2725 +/- 145K
 - ii. Amber

- b. Indoor:
 - iii. 3500K defined as 3465 +/- 245K
 - iv. 4000K defined as 3985 +/- 275K
- 2. Color spatial uniformity shall be limited to variations in chromaticity for different directions within 0.004 from the weighted average point on the CIE 1976 (u',v') diagram.
- 3. Color maintenance shall be limited to a maximum change in chromaticity of 0.007 on the CIE 1976 (u',v') diagram over the lifetime of the product.
- 4. Color rendering index.
 - a. Color rendering index to be determined using ANSI C78.377-2008 and applicable IESNA standards.
 - b. Laboratory tests must be produced using specific module(s)/array(s) and power supply combination that will be used in production.
 - c. Manufacturers must provide a test report from a laboratory accredited by NVLAP or one of its MRA signatories.
- 5. Lumen depreciation.
 - a. Lumen depreciation to be measured using IESNA LM-80-08 standard for IES approved method of measuring lumen maintenance of LED light sources.
 - b. Phosphor coated white LED module(s)/array(s) shall deliver at least 70% of initial lumens for a minimum of 35,000 hours when installed in-situ and operated at 100% output and the maximum specified operating temperature.
 - c. Colored LED module(s)/array(s) shall deliver at least 50% of initial lumens for a minimum of 35,000 hours when installed in-situ and operated at 100% output and the maximum specified operating temperature.
- 6. Acceptable LED manufacturers:
 - a. CREE
 - b. Nichia
 - c. Osram Opto Semiconductors
 - d. Philips Lumileds

D. Luminaire Efficacy:

- 1. Luminaire efficiency shall be measured using IESNA LM-79-08 standard for electrical and photometric measurements of solid state lighting products.
- 2. Manufacturer shall provide published luminaire efficacy, which is defined as luminaire light output divided by luminaire input power measured in a 25 degree Celsius environment. Efficacy shall include power supply, thermal, optical, and fixture losses. Minimum efficacy of 80 lumens per watt.

E. Thermal Management:

- 1. Solid state light fixture shall not exceed LED manufacturer's maximum junction temperature requirements when operated in-situ at fixture manufacturer's maximum ambient operating temperature and 100% light output.
- 2. Solid state light fixtures shall be thermally protected using one or more of the following thermal management techniques:
 - a. Metal core board
 - b. Gap pad
 - c. Internal monitoring firmware

3. Solid state lighting fixture housing shall be designed to transfer heat from the LED board to the outside environment.

F. Power Supplies/Drivers:

1. Power supply shall have a power factor of 0.90 or greater for primary application.
2. Power supply input current shall have Total Harmonic Distortion (THD) of less than 20%.
3. Power supply shall have a minimum operating temperature of minus 20 degrees Celsius or below when used in luminaires intended for outdoor applications.
4. Power supply output operating frequency to be equal to or greater than 120Hz.
5. Power supply shall operate with sustained input variations of +/- 10% (voltage and frequency) with no damage to the driver.
6. Power supply shall tolerate sustained open circuit and short circuit output conditions without damage and without need for external fuses or trip devices.
7. Power supply output shall be regulated to +/- 5% across published load range.
8. Power supply shall have a Class A sound rating.
9. Power supply outputs shall have current limiting protection.
10. Power supply shall operate LEDs at constant and regulated current levels. LEDs shall not be overdriven beyond the diode manufacturer's specified nominal voltage and current.

G. Solid State Lighting Controls:

1. Control interface to dimmable power supplies shall consist of one of the following:
 - a. Line Voltage Dimming. Controls to be rated for magnetic or electronic low voltage transformer operation.
 - b. Low voltage (0-10V) control. Controls to be compatible with either current sink or current source operation.
2. Dimmable LED power supplies shall use pulse width modulation (PWM) to regulate power to LEDs
 - a. Dimmable power supplies shall have 12-bit or greater resolution to obtain flicker-free operation throughout the dimming range.

H. System Installation:

1. All hardwired connections to solid state lighting fixtures shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
 2. All solid state lighting fixtures (100% of each lot) shall undergo a minimum eight-hour burn-in test during manufacturing.
 3. Solid state lighting installations shall be UL listed as a low-voltage lighting system including, but not limited to, luminaire, power supply, controller, keypad, and wiring.
- I. Warranty: Luminaires, drivers, and controllers for solid state lighting systems shall be covered by a two-year warranty against defects in workmanship or material. Warranty shall include in-warranty service program providing for payment of authorized labor charges incurred in replacement of inoperative in-warranty equipment.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).
- F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- C. Adjust aimable lighting fixtures to provide required light intensities.
- D. Retrofit power, lighting and controls will impact interior surfaces in public spaces that are highly character defining. If new installations are not concealed it potentially changes the historic appearance and surface anchorage may result in loss of fabric that degrades the quality of the resource. New equipment and materials choices must be concealed or compatible with the historic surface to avoid obtrusiveness. Major alterations should be relegated to least important locations. Careful choices for materials, finishes, fixtures, and service runs can help preserve the character of the property.

END OF SECTION 26 51 00

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Grounding conductors.
 - 2. Grounding connectors.
 - 3. Grounding busbars.
 - 4. Grounding rods.
 - 5. Grounding labeling.

1.2 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. EMT: Electrical metallic tubing.
- C. TGB: Telecommunications grounding busbar.
- D. TMGB: Telecommunications main grounding busbar.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician, who shall be present at all times when Work of this Section is performed at Project site.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

- A. Comply with J-STD-607-A.

2.2 CONDUCTORS

- A. Comply with UL 486A-486B.
- B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
- C. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kmils (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.3 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
 - 1. Electroplated tinned copper, C and H shaped.
- C. Busbar Connectors: Cast silicon bronze, solderless compression-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.

2.4 GROUNDING BUSBARS

- A. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-A.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide a 4-inch (100-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

2.5 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with J-STD-607-A.

3.3 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 1. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

- B. Underground Grounding Conductors: Install bare copper conductor, No. 2 AWG minimum.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Connections to Structural Steel: Welded connectors.
- D. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm).
- E. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install without splices.
 - 3. Support at not more than 36-inch (900-mm) intervals.
 - 4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TMGB/TGB.

3.4 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.

3.5 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pretwist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

- E. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system.
- F. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TMGB to the vertical steel of the building frame.
- G. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

3.6 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
 - 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
 - 2. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
 - 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
 - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB. Maximum acceptable ac current level is 1 A.
- C. Prepare test and inspection reports.

END OF SECTION 270526

SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Optical-fiber-cable pathways and fittings.
 - 4. Boxes, enclosures, and cabinets.
- B. Related Requirements:
 - 1. Section 26 05 33 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.

1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. GRC: Galvanized rigid conduit.

1.3 ACTION SUBMITTALS

- A. Product data for the following:
 - 1. Boxes, enclosures, and cabinets.
 - 2. Underground handholes and boxes.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of pathway groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
 - 3. Underground ducts, piping, and structures in location of underground enclosures and handholes.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. General Requirements for Metal Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
 - 2. Comply with TIA-569-D.

- C. EMT: Comply with ANSI C80.3 and UL 797.
- D. PVC-Coated Steel Conduit: PVC-coated GRC.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- E. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: compression.
 - 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions, where installed and including flexible external bonding jumper.
 - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints
- F. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.
- B. General Requirements for Nonmetallic Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 2. Comply with TIA-569-D.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Continuous HDPE: Comply with UL 651A.
- E. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- F. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Description: Comply with UL 2024.
 - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 2. Comply with TIA-569-D.
- B. The use of non-metallic conduit or tubing is not allowed in interior dry locations unless required by code.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Description: Enclosures for communications.
- B. General Requirements for Boxes, Enclosures, and Cabinets:
 - 1. Comply with TIA-569-D.
 - 2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
 - 3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
 - 4. Device Box Dimensions: 4-11/16 inches square by 2-1/8 inches deep.

5. Conduit knockout provisions: Two opposing sides shall each have at least one concentric knockout for either 1 inch or 1-1/4 inch conduit.
6. Gangable boxes are prohibited.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with a gasketed cover.
- E. Metal Floor Boxes:
 1. Material: Cast metal or sheet metal.
 2. Type: Fully adjustable, Semi-adjustable.
 3. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Nonmetallic Floor Boxes: Nonadjustable, round or rectangular.
 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 (indoor) or Type 4X (outdoor), with continuous-hinge cover with flush latch unless otherwise indicated.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures: Plastic or fiberglass, finished inside with radio-frequency-resistant paint.
 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- K. Cabinets:
 1. NEMA 250, Type 1 (indoor) or Type 4X (outdoor) galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.
 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
 1. Exposed Conduit: GRC.
 2. Concealed Conduit, Aboveground: GRC.
 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 4. Boxes and Enclosures, above ground: NEMA 250, Type 4X.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 4. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 5. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 6. Damp or Wet Locations: GRC.
 7. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
 8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT.
 9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size:
1. Copper and aluminum cables: 3/4-inch trade size.
 2. Optical-fiber cables: 1-inch trade size. Size conduits appropriated to meet the installation requirements as indicated in ANSI/TIA – 569B. Appropriate bend radius shall be maintained.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg. F, (49 deg. C).

3.2 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter.
1. NECA 1.
 2. NECA/BICSI 568.
 3. TIA-569-D.
 4. NECA 101
 5. NECA 102.
 6. NECA 105.
 7. NECA 111.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

- C. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.
- F. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- G. Complete pathway installation before starting conductor installation.
- H. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- I. Install no more than the equivalent of two 90-degree bends in any pathway run. For runs that total more than 30m, (100') in length, pull points or pull boxes should be inserted so that no segment between points/boxes exceeds the 30m, (100'). Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
- J. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- K. Stub-ups to Above Recessed Ceilings: Not permitted. All conduits shall home-run back to IT serving room.
- L. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- M. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- N. Pathways Embedded in Slabs: Not permitted to be embedded horizontally within slabs.
- O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- Q. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- S. Spare Pathways: Install pull wires in empty pathways. Cap underground pathways designated as spare above grade alongside pathways in use.
- T. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound.
- U. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service pathway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- V. Expansion-Joint Fittings:
 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg. F, (17 deg. C) and that has straight-run length that exceeds 25 feet, (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg. F, (55 deg. C) and that has straight-run length that exceeds 100 feet, (30 m).
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

- a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg. F, (70 deg. C), temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg. F, (86 deg. C), temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg. F, (70 deg. C), temperature change.
 - d. Ceilings and Attics: 135 deg. F, (75 deg. C), temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg. F, (0.06 mm per meter of length of straight run per deg. (C), of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg., F, (0.0115), mm per meter of length of straight run per deg., (C), of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- W. Mount boxes at heights indicated on Drawings in accordance with ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
- X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 2000 "Earth Moving" for pipe less than 6 inches, (150 mm), in nominal diameter.
 2. Install backfill as specified in Section 31 2000 "Earth Moving."
 3. After installing conduit, backfill and compact. After placing controlled backfill to within 12 inches, (300 mm), of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 2000, "Earth Moving."
 4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches, (75 mm), of concrete for a minimum of 12 inches, (300 mm), on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches, (1500 mm), from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
 5. Underground Warning Tape: Comply with requirements in Section 26 0553 "Identification for Electrical Systems."
 6. Install Tracer wire with all underground fiber optic pathway installations.
 1. Tracer wire shall be 14-18AWG, stranded or solid conductor, low voltage rated up to 600v, direct buried rated.

- 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES
- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
 - B. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch, (25 mm), above finished grade.
 - C. Install handholes in accordance with manufacturer's specifications and instructions.
 - D. Field cut openings for conduits according to enclosure manufacturer's written instructions.
- 3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 27 0544, "Sleeves and Sleeve Seals for Communications Pathways and Cabling."
- 3.6 PROTECTION
- A. Protect coatings, finishes, and cabinets from damage or deterioration.

END OF SECTION 27 0528

SECTION 27 05 44 - SLEEVES & SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS & CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch, (0.6-mm), minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized-steel sheet.
2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches, (1270 mm) and with no side larger than 16 inches, (400 mm), thickness shall be 0.052 inch, (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter 50 inches, (1270 mm), or more and one or more sides larger than 16 inches, (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 - 2. Sealing Elements: EPDM, Nitrile, (Buna N), rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel, Plastic, Stainless steel.
 - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel with length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Presealed Systems.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm), annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed, or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel, cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 270544

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks and cabinets.
4. Power strips.
5. Grounding.

B. Related Requirements:

1. Section 271513 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.
2. Section 270526 "Grounding and Bonding for Communications systems"

1.2 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. LAN: Local area network.
- C. RCDD: Registered Communications Distribution Designer.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD/NTS.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician or Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Field Inspector: Currently registered by BICSI as RCDD or Commercial Installer, Level 2 to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Section 061000 "Rough Carpentry."

2.2 LABELING

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.3 CABLE MANAGEMENT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Chatsworth Products Inc.
 - 2. Middle Atlantic Products Inc.
 - 3. Legrand
 - 4. Pentair / Hoffman
 - 5. Panduit
 - 6. Hubbell Premise Wiring
- B. Cable Management:
 - 1. Metal, with integral wire retaining fingers.
 - 2. Baked-polyester powder coat finish.
 - 3. Vertical cable management panels shall have front and rear channels, with covers.

4. Provide horizontal crossover cable managers for each patch panel installed.

C. Features and Accessories:

1. Cable access provisions in the roof and base.
2. Grounding bus bar.
3. Power strip.
4. Baked-polyester powder coat finish.

D. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.4 Equipment Racks/Cabinets

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chatsworth Products Inc. – Cube IT
2. Middle Atlantic Products Inc. – CWR
3. Legrand – SWM

B. Features and Accessories:

1. 19RU
2. Supports swing out, for easy access to rear of cabinet.
3. Supports mounting of power strip.
4. Baked-polyester powder coat finish.
5. All screws/cage nuts to mount hardware to be installed/relocated into cabinet.
6. Lockable

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Comply with requirements in Section 270528 "Pathways for Communications Systems" for materials and installation requirements for underground pathways.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

- D. Coordinate installation of communications equipment with Contracting Officer's telecommunications and LAN equipment and service suppliers.
- E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.3 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

- A. Comply with TIA-569-D, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements in Section 260553 "Identification for Electrical Systems."
- B. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA-606-B.
- D. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fiber Optic Cabling.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

1.4 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms (hall 110) or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration Drawings and printouts.
 - 4. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Telecommunications rooms plans and elevations.
 - b. Telecommunications pathways.
 - c. Telecommunications system access points.
 - d. Telecommunications grounding system
 - e. Patch panels.
 - f. Patch cords.
 - 5. Patch Panels: Detail mounting assemblies, and show elevations and physical relationship between the installed components.
- C. Twisted pair and fiber cable testing plan.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For RCDD, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Product Certificates: For each type of product.
- D. Field quality-control reports.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- E. Grounding: Comply with ANSI-J-STD-607-A.

1.9 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Contracting Officer.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Conduit and Boxes: Comply with requirements in Division 27 Section "Pathways for Communications Systems." Flexible metal conduit shall not be used.

2.2 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Belden CDT Inc.; Electronics Division.
 2. Berk-Tek; a Nexans company.
 3. CommScope, Inc.
 4. Draka USA.
 5. Genesis Cable Products; Honeywell International, Inc.
 6. KRONE Incorporated.
 7. Mohawk; a division of Belden CDT.
 8. Nordex/CDT; a subsidiary of Cable Design Technologies.
 9. Superior Essex Inc.
 10. SYSTIMAX Solutions; a CommScope Inc. brand.
 11. 3M.
 12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. Description: 100-ohm, 100 pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6a.
4. All exterior cables are to be OSP rated with waterproof sheathing.
5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 - b. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.

2.3 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. American Technology Systems Industries, Inc.
 2. Dynacom Corporation.
 3. Hubbell Premise Wiring.
 4. KRONE Incorporated.
 5. Leviton Voice & Data Division.
 6. Molex Premise Networks; a division of Molex, Inc.
 7. Nordex/CDT; a subsidiary of Cable Design Technologies.
 8. Panduit Corp.
 9. Siemon Co. (The).
 10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 6a. Provide blocks for the number of cables terminated on the block, plus 25% spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- G. Patch Cords: Factory-made, 4-pair cables in 36-inch lengths; terminated with 8-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

2.4 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Berk-Tek; a Nexans company.
2. CommScope, Inc.
3. Corning Cable Systems.
4. General Cable Technologies Corporation.
5. Mohawk; a division of Belden CDT.
6. Nordex/CDT; a subsidiary of Cable Design Technologies.
7. Optical Connectivity Solutions Division; Emerson Network Power.
8. Superior Essex Inc.
9. SYSTIMAX Solutions; a CommScope Inc. brand.
10. 3M.
11. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
12. Panduit

B. Description: Singlemode, 12-fiber, nonconductive, tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA/EIA-568-B.3 for performance specifications.
3. All exterior cables are to be OSP rated with waterproof sheathing.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. Outdoor Rated, Nonconductive: Type OSP

C. Jacket:

1. Jacket Color: Yellow for singlemode fiber, with black outer jacket.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.5 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ADC.
2. American Technology Systems Industries, Inc.
3. Berk-Tek; a Nexans company.
4. Corning Cable Systems.
5. Dynacom Corporation.
6. Hubbell Premise Wiring.

7. Molex Premise Networks; a division of Molex, Inc.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Optical Connectivity Solutions Division; Emerson Network Power.
10. Siemon Co. (The).

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

D. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
2. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.
3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.6 GROUNDING

- A. Comply with requirements in Division 27 Section "Grounding and Bonding for Communication Systems." for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in conduit. Conceal raceway and cables except in unfinished spaces.

1. Conduit and Boxes: Comply with requirements in Division 27 Section "Pathways for Communications Systems."
- B. Wiring Method: Conceal conduit above accessible ceilings where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

1.2 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- C. Conduit and Boxes: Comply with requirements in Division 27 Section "Pathways for Communications Systems."
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Pathway Installation in Communications Equipment Rooms:
 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 2. Install cable trays to route cables if conduits cannot be located in these positions.
 3. Secure conduits to backboard when entering room from overhead.
 4. Extend conduits 3 inches above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

1.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 1. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 2. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.

3. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
4. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

1.4 FIRESTOPPING

- A. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

1.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

1.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements.
- C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- E. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

1.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.

- 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
 - c. Prior to system acceptance, contractor shall test and verify all installed cabling to be within the requirements as specified by manufacturer and IEEE for cabling specified.
 - d. Testing results shall be recorded and submitted to include dB levels and pass/fail designation.
- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
 - D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
 - E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
 - F. Prepare test and inspection reports.

END OF SECTION 16716

SECTION 27 15 00 – COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pathways.
 - 2. UTP cabling.
 - 3. Cable connecting hardware, patch panels, and cross-connects.
 - 4. Telecommunications outlet/connectors.
 - 5. Cabling system identification products.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. LAN: Local area network.
- E. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- F. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- G. RCDD: Registered Communications Distribution Designer.
- H. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. NPS network standards require that a minimum of four telecommunications outlet/connectors be installed for each work area.
 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 3. Bridged taps and splices shall not be installed in the horizontal cabling.
 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect, when cabling leaves the communications equipment room.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 3. Cabling administration Drawings and printouts.
 4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:
 - a. Telecommunications rooms plans and elevations.
 - b. Telecommunications pathways.
 - c. Telecommunications system access points.
 - d. Telecommunications grounding system.
 - e. Telecommunications conductor drop locations.
 - f. Typical telecommunications details.
 - g. Mechanical, electrical, and plumbing systems.
- C. Twisted pair cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For RCDD, installation supervisor, and field inspector.
- B. Product Certificates: For each type of product.
- C. Source quality-control reports.
- D. Field quality-control reports.

1.7 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- C. Grounding: Comply with ANSI-J-STD-607-A.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of UTP cable for open and short circuits.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.11 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Government's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.12 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Connecting Blocks: One of each type.
 - 2. Device Plates: One of each type.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Conduit and Boxes: Comply with requirements in Division 27 Section "Pathways for Communications Systems."
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the:
 - 1. Belden CDT Inc.; Electronics Division.
 - 2. Berk-Tek; a Nexans company.
 - 3. CommScope, Inc.
 - 4. Mohawk; a division of Belden CDT.
 - 5. Superior Essex Inc.
 - 6. SYSTIMAX Solutions; a CommScope, Inc. brand.
- B. Description: 100-ohm, 4-pair UTP.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 - 3. Comply with TIA/EIA-568-B.2, Category 6a.
 - 4. Data Cabling: Blue Sheath color.
 - 5. Telephone Cabling: White Sheath color.
 - 6. All exterior cables are to be OSP rated with waterproof sheathing.
 - 7. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG.
 - b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR, complying with UL 1666.

2.3 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Belden
 - 2. CommScope
 - 3. Dynacom Corporation.
 - 4. Hubbell Premise Wiring.
 - 5. Panduit Corp.

- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 6a. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- G. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6a performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.

2.4 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: Four-port-connector assemblies mounted in single faceplate.
 - 1. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
 - 2. Legend: Snap-in, clear-label covers and machine-printed paper inserts.
 - 3. Unused Positions: Any unused positions within faceplate shall be covered using a blank insert
- C. Wall Phone: The wall-phone faceplate shall be a white colored or stainless steel single-port faceplate with mounting lugs.

2.5 GROUNDING

- A. Comply with requirements in Division 27 Section "Grounding and Bonding for Telecommunications Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Division 27 Section "Pathways for Communications Systems."
- B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Division 27 Section "Pathways for Communications Systems" for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Conduits should be painted to match surrounding finishes.
- F. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.

3. Secure conduits to backboard when entering room from overhead.
 4. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
1. Comply with TIA/EIA-568-B.1.
 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 3. Install 110-style IDC termination hardware unless otherwise indicated.
 4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 5. Cables may not be spliced. Secure and support cables at intervals not exceeding more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 9. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
 10. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
 11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Group connecting hardware for cables into separate logical fields.

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. For this project, the requirements for labeling telecommuting components are identical with that of those found in section 260544. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

C. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.6 TESTING REQUIREMENTS

- A. Prior to system acceptance, contractor shall test and verify all installed cabling to be within the requirements as specified by manufacturer and IEEE for category cabling specified.
- B. Testing results shall be recorded and submitted to include dB levels and pass/fail designation.

END OF SECTION 27 15 00

SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Electronic safety and security equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electronic safety and security installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: [EPDM] [NBR] interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: [Plastic] [Carbon steel] [Stainless steel]. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: [Carbon steel with corrosion-resistant coating] [Stainless steel] of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

- A. Electronic safety and security penetrations occur when raceways, pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [steel] [cast-iron] pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 280500

SECTION 28 16 00 - INTRUSION DETECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Intrusion detection with hard-wired, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.

1.3 DEFINITIONS

- A. LCD: Liquid-crystal display.
- B. LED: Light-emitting diode.
- C. PIR: Passive infrared.
- D. RFI: Radio-frequency interference.
- E. UPS: Uninterruptible power supply.
- F. Protected or Protection Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.
- G. Standard Intruder: A person who weighs 100 lb or less and whose height is 60 inches or less.
- H. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.

1.4 SUBMITTALS

- A. Product Data: Components for sensing, detecting, and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.
 - 1. Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate methods used to achieve systems integration. Indicate control, signal, and data communication paths and identify control interface devices and media to be used.
 - 2. Raceway Riser Diagrams: Detail raceway runs required for intrusion detection and for systems integration. Include designation of devices connected by raceway, raceway type, and size, and type and size of wire and cable fill for each raceway run.
 - 3. UPS: Sizing calculations.

4. Site and Floor Plans: Indicate final outlet and device locations, routing of raceways, and cables.
 5. Device Address List: Coordinate with final system programming.
 6. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
 7. Details of surge-protection devices and their installation.
 8. Sensor detection patterns and adjustment ranges.
- C. Equipment and System Operation Description: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are not acceptable.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Data for each type of product, including features and operating sequences, both automatic and manual.
- F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
1. An employer of workers, at least one of whom is a technician certified by the National Burglar & Fire Alarm Association.
 2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. 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.
- C. FMG Compliance: FMG-approved and -labeled intrusion detection devices and equipment.
- D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
1. Interior, Controlled Environment: System components installed in temperature-controlled interior environments shall be rated for continuous operation in ambients of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products compatible with existing systems.

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. Supervision: System components shall be continuously monitored for normal, alarm, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.
 - 1. Alarm Signal: Display at central-station control unit and actuate audible and visual alarm devices.
 - 2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or controller failure.
- B. System Control: Central-station control unit shall directly monitor intrusion detection units and connecting wiring.
- C. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.
- D. Operator Commands:
 - 1. Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.
 - 2. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
 - 3. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
 - 4. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.
 - 5. Protected Zone Test: Initiate operational test of a specific protected zone.
 - 6. System Test: Initiate system-wide operational test.
- E. Timed Control at Central-Station Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.
- F. Response Time: Two seconds between actuation of any alarm and its indication at central-station control unit.

- G. Circuit Supervision: Supervise all signal and data transmission lines, and sensors from central-station control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at central-station control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.
- H. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.

2.3 ENCLOSURES

- A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.
- B. Interior Electronics: NEMA 250, Type 12.
- C. Screw Covers: Where enclosures are accessible to inmates, secure with security fasteners of type appropriate for enclosure.

2.4 SECURE AND ACCESS DEVICES

- A. New devices shall have specifications as below
 - 1. Manufacturers (or approved equal to the following):
 - a. Hirsch by Identiv
 - 1) For system card reader / keypads provide PIV ScramblePad
 - 2) For system head-end provide rack-mount Mx Controller

2.5 DOOR SWITCHES

- A. Add new devices as shown on Technology drawings. All devices shall have specifications as below.
 - 1. Manufacturers (or approved equal to the following):
 - a. Interlogix United Technologies, Aritech
- B. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of two encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of intrusion detection.

1. Examine rough-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.
 2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.
- B. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SYSTEM INSTALLATION

- A. Connecting to Existing Equipment: Verify that existing perimeter security system is operational before making changes or connections.
1. Connect new equipment to existing control panel in existing part of the building.
 2. Connect new equipment to existing monitoring equipment at the Supervising Station.
 3. Expand, modify, and supplement existing head end equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- B. Comply with UL 681.

3.3 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceways according to Division 26 Section "Raceway and Boxes for Electrical Systems." Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Wiring Method: Install wiring in raceways in all locations. Refer to plans for anticipated raceway locations.
- C. Wires and Cables:
1. Conductors: Size as recommended in writing by system manufacturer, unless otherwise indicated.
 2. 120-V Power Wiring: Install according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables," unless otherwise indicated.
 3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable, unless otherwise indicated or if manufacturer recommends shielded cable.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- E. Install power supplies and other auxiliary components for detection devices at controllers, unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

- F. Identify components with engraved, laminated-plastic or metal nameplate for central-station control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

3.4 GROUNDING

- A. Verify the master control unit and associated circuits are grounded and comply with IEEE 1100. Install a ground wire from main service ground to master control unit, as needed.
- B. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- C. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
 - 1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.
- B. Perform the following field tests and inspections and prepare reports:
 - 1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
 - 2. Operational Tests: Schedule tests after pretesting has been successfully completed. Test all modes of system operation and intrusion detection at each detection device. Test for detection of intrusion and for false alarms in each protected zone. Test for false alarms by simulating activities outside indicated detection patterns.
 - 3. Electrical Tests: Comply with NFPA 72, Section A-7. Minimum required tests are as follows:
 - a. Verify the absence of unwanted voltages between circuit conductors and ground.
 - b. Test all conductors for short circuits using an insulation-testing device.
 - c. With each circuit pair, short circuit at the far end of circuit and measure circuit resistance with an ohmmeter. Record circuit resistance of each circuit on Record Drawings.
 - d. Verify that each controller is in normal condition as detailed in manufacturer's operation and maintenance manual.
 - e. Test signal and data transmission circuits complying with requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security" for proper signal transmission under open-circuit conditions. One connection each should be opened at not less than 10 percent of initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
 - f. Verify that transient surge-protection devices are installed according to manufacturer's written instructions.
 - g. Test each initiating and indicating device for alarm operation and proper response at central-station control unit.

- h. Test both primary and secondary power. Verify, by test, that UPS is capable of operating the system for period and in manner specified.
- C. Base bid: Ensure compatibility with existing devices and head-end control system.
- D. Report of Tests and Inspections: Prepare a written record of tests, inspections, and detailed test results in the form of a test log.
- E. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Park's maintenance personnel to adjust, operate, and maintain intrusion detection. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 282300 - VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide new turn-key IP-based video surveillance system as shown on Technology Plans and Security Cameras schedule on T5.0.
- B. This Section includes video surveillance system consisting of cameras, data transmission wiring, and associated equipment.

1.3 DEFINITIONS

- A. AGC: Automatic gain control.
- B. B/W: Black and white.
- C. CCD: Charge-coupled device.
- D. MPEG: Moving picture experts group.
- E. NTSC: National Television System Committee.
- F. UPS: Uninterruptible power supply.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.
 - 1. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
 - 2. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
 - 3. UPS: Sizing calculations.
 - 4. Wiring Diagrams: Power, signal, and control wiring, and grounding.
- C. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.
- D. Field quality-control test reports.

- E. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data" include the following:
 - 1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.
- F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. 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.
- B. Comply with NECA 1.
- C. Comply with NFPA 70.
- D. Electronic data exchange between video surveillance system with an access control system shall comply with SIA TVAC.

1.6 PROJECT CONDITIONS

- A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
 - 1. Control Station: Rated for continuous operation in ambient temperatures of 60 to 85 deg F (16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
 - 2. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 1 enclosures.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products compatible with existing systems.

2.2 SYSTEM REQUIREMENTS

- A. Video signal format shall comply with the NTSC standard composite video, interlaced. Composite video signal termination shall be 75 ohms.

- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
 - 1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits."
 - 2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.
- C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

2.3 STANDARD CAMERAS

- A. Manufacturers:
 - 1. Avigilon
 - a. 3.0C-HD-LP-B1
 - b. ES-HD-LP-HS
 - c. ES-HD-IR-IP6
 - d. ACC7-LPR (x2)
 - 2. Or approved equal
- B. Color Camera (camera is to be color, not black and white, with no sound):
 - 1. Comply with UL 60950 – UL standard for Safety Information Technology Equipment.
 - 2. Housing: IP66-rated, impact-resistant aluminum enclosure with integrated dehumidifying membrane.
 - 3. Pickup Device: CCD interline transfer, 380,000, 771(H) by 492(V) pixels.
 - 4. Horizontal Resolution: 480 lines.
 - 5. Sensitivity: Camera shall provide usable images in low-light conditions, delivering an image at a scene illumination of 2 footcandles.
 - 6. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. The illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with the camera AGC off.
 - 7. Scanning Synchronization: Determined by external synch over the category 6 cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
 - 8. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
 - 9. Motion Detector: Built-in digital.

2.4 IP VIDEO SYSTEMS

- A. Description:
 - 1. System shall provide high-quality delivery and processing of IP-based video, audio, and control data using standard Ethernet-based networks.
 - 2. System shall have seamless integration of all video surveillance and control functions.
 - 3. All camera signals shall be compressed, encoded, and delivered onto the network for processing and control by the existing IP video-management software.

4. Camera system units shall be ruggedly built and designed for extreme adverse environments, complying with NEMA Type environmental standards.
5. Encoder/decoder combinations shall place video, audio, and data network stream that can be managed from multiple workstations on the user's LAN or WAN.

2.5 SIGNAL TRANSMISSION COMPONENTS

- A. Provide and install CAT-6A plenum-rated cable where required for all cameras and storage array connections. New cabling shall be run in metal conduit back to Elec/IT 105.

PART 3 - EXECUTION

3.1 WIRING

- A. Wiring Method: Install cables in raceways and as otherwise indicated on plans.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- C. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.2 VIDEO SURVEILLANCE SYSTEM INSTALLATION

- A. Install cameras level and plumb.
- B. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system component enclosures, and mounted in self-protected, inconspicuous positions.
- C. Avoid ground loops by making ground connections at only the control station.
 1. For 12- and 24-V dc cameras, connect the cable shields only at the monitor end.
- D. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Identification of Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video surveillance equipment for acceptance and operational testing as follows:
 1. Prepare equipment list described in Part 1 "Submittals" Article.
 2. Verify operation of auto-iris lenses.

3. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
 4. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object at opposite side of rotunda. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
 5. Set and name all preset positions; consult Park's personnel.
 6. Set sensitivity of motion detection.
 7. Connect and verify responses to alarms.
- B. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
- C. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
- D. Remove and replace malfunctioning items and retest as specified above.
- E. Record test results for each piece of equipment.
- F. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- 3.4 CLEANING
- A. Clean installed items using methods and materials recommended in writing by manufacturer.
 - B. Clean video surveillance system components, including camera-housing windows, lenses, and monitor screens.
- 3.5 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Park's maintenance personnel to adjust, operate, and maintain video surveillance equipment.
 1. Train Park's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment.
 2. Demonstrate methods of determining optimum alignment and adjustment of components and settings for system controls.
 3. Review equipment list and data in maintenance manuals. Refer to Division 01 Section "Operation and Maintenance Data"
 4. Conduct a minimum of three hours' training as specified in instructions to Park's employees in Division 01 Section "Demonstration and Training"

END OF SECTION

SECTION 28 31 11 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Magnetic door holders.
 - 7. Remote annunciator.
 - 8. Addressable interface device.
 - 9. Digital alarm communicator transmitter.
 - 10. Network communications.

1.3 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. HLI: High Level Interface.
- D. NICET: National Institute for Certification in Engineering Technologies.
- E. PC: Personal computer.
- F. VESDA: Very Early Smoke-Detection Apparatus.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
12. Include floor plans to indicate final outlet locations showing address of each addressable device.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Contracting Officer.
2. The authority having jurisdiction for this project is the IMRO structural Fire Branch Chief.
3. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified, fire-alarm technician; Level III minimum.
 - c. Licensed or certified with the approval from the authority having jurisdiction.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.6 Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

- a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
- c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
- d. Riser diagram.
- e. Device addresses.
- f. Record copy of site-specific software.
- g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
- h. Manufacturer's required maintenance related to system warranty requirements.
- i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

- B. Software and Firmware Operational Documentation:

- 1. Software operating and upgrade manuals.
- 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
- 3. Device address list.
- 4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
 - 2. Keys and Tools: One extra set for access to locked or tamperproofed components.
 - 3. Audible and Visual Notification Appliances: One of each type installed.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.
- C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).
- D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.
- E. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.

1.10 PROJECT CONDITIONS

- A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Noncoded,UL-certified addressable system, with multiplexed signal transmission and voice /strobe evacuation.
- B. Automatic sensitivity control of certain smoke detectors.

- C. All components provided shall be listed for use with the selected system.
- D. Electrical Components, Cabling, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amseco - a Potter brand; Potter Electric Signal Company.
 - 2. Autocall; a Johnson Controls company.
 - 3. Bosch Security Systems.
 - 4. Commercial Products Group/CPG Life Safety Signals.
 - 5. Faraday; Siemens Building Technologies, Inc.
 - 6. Federal Signal Corporation.
 - 7. Fire Control Instruments, Inc.; a Honeywell company.
 - 8. Fire Lite Alarms; a Honeywell company.
 - 9. Gamewell; a Honeywell company.
 - 10. GE Infrastructure; a unit of General Electric Company.
 - 11. Gentex Corporation.
 - 12. Harrington Signal, Inc.
 - 13. NOTIFIER; a Honeywell company.
 - 14. Siemens Building Technologies, Inc.; Fire Safety Division.
 - 15. Silent Knight; a Honeywell company.
 - 16. SimplexGrinnell LP; a Tyco International company.

2.3 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
 - 4. Duct smoke detectors.
 - 5. Carbon monoxide detectors.
 - 6. Automatic sprinkler system water flow.
 - 7. Fire-extinguishing system operation.
 - 8. Fire standpipe system.
- B. Fire-alarm signal shall initiate the following actions:
 - 1. Continuously operate alarm notification appliances, including voice evacuation notices.
 - 2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
 - 3. Unlock electric door locks in designated egress paths.
 - 4. Release fire and smoke doors held open by magnetic door holders.
 - 5. Activate voice/alarm communication system.
 - 6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.

7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Activate emergency lighting control.
9. Activate emergency shutoffs for gas and fuel supplies.
10. Record events in the system memory.
11. Record events by the system printer.
12. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Alert and Action signals of air-sampling detector system.
3. Independent fire-detection and -suppression systems.
4. User disabling of zones or individual devices.
5. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Voice signal amplifier failure.

2.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified"

2.5 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
 - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.

- b. Include a real-time clock for time annotation of events on the event recorder and printer.
 - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
 - d. The FACP shall be listed for connection to a central-station signaling system service.
 - e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
- 2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
 - 3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
- 1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
 - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- C. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
- 1. Pathway Class Designations: NFPA 72, Class B.
 - 2. Pathway Survivability: Level 1.
 - 3. Install no more than 256 addressable devices on each signaling-line circuit.
 - 4. Serial Interfaces:
 - a. One dedicated RS 485 port for central-station operation using point ID DACT.
 - b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - c. One RS 485 port for PC configuration.
 - d. One RS 232 port for voice evacuation interface.
- D. Addressable CO Sounder Base
- 1. The CO Sensor shall be an addressable carbon monoxide (CO) sensing module providing both CO toxic gas detection and enhanced fire detection, and shall be listed to UL 268, Smoke Detectors for Fire Alarm Signaling Systems and UL 2075, Gas and Vapor Detectors and Sensors; allowing systems to be listed to Standard 2034, Single and Multiple Station Carbon Monoxide Alarms.
 - a. The CO Sensing element shall support operation with a Sounder base; the CO Sounder base shall provide temporal code 3 (TC3) for fire, or temporal code 4 (TC4) for toxic carbon monoxide alarms.
 - b. The CO Sounder base shall be listed to UL464, Audible Signal Appliances.

- c. CO sensor shall provide enhanced fire detection with the addition of two selectable modes of operation: Nuisance Alarm Reduction Mode and Faster Fire Detection.
- d. The CO Sounder Base shall include CO sensor element mounted in the sounder base which can be easily replaced without replacing the complete sensor base assembly.
- e. The CO Sounder base shall provide address selection in the base allowing the address to remain with its location when the sensor is removed for service or type change.
- f. The CO Sounder Sensor base shall include an integral red LED to indicate the power-on, trouble, test mode or alarm status.
- g. The CO Sensor base shall report the following CO Sensor troubles: Communication loss, Disabled, Almost Expired 12 Months, Almost Expired 6 Months, Expired (End of Life), and Sensor Missing/Failed.

E. Smoke-Alarm Verification:

- 1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
- 2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
- 3. Record events by the system printer.
- 4. Sound general alarm if the alarm is verified.
- 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification-Appliance Circuit:

- 1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
- 2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

J. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

- K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
 - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries: Sealed lead calcium.
- M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.6 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 2. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 3. Station Reset: Key- or wrench-operated switch.
 - 4. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
 - 5. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.7 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Detectors shall be two-wire type.
 - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

6. Integral Visual-Indicating Light: LED type, indicating detector has operated
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
 - b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
 - c. Multiple levels of detection sensitivity for each sensor.
 - d. Sensitivity levels based on time of day.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.8 CARBON MONOXIDE DETECTORS

- A. General: Carbon monoxide detector listed for connection to fire-alarm system.
 - 1. Mounting: Adapter plate for outlet box mounting.
 - 2. Testable by introducing test carbon monoxide into the sensing cell.
 - 3. Detector shall provide alarm contacts and trouble contacts.
 - 4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
 - 5. Comply with UL 2075.
 - 6. Locate, mount, and wire according to manufacturer's written instructions.
 - 7. Provide means for addressable connection to fire-alarm system.
 - 8. Test button simulates an alarm condition.

2.9 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
 - 1. Temperature sensors shall test for and communicate the sensitivity range of the device.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.10 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
 - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- B. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.
- C. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
- D. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
- E. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:
 - a. 15 30 75 110 177 cd.
 - b. 15/30/75/110 cd, selectable in the field.
2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

F. Voice/Tone Notification Appliances:

1. Comply with UL 1480.
2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
3. Low-Range Units: Rated 1/4 to 2 W.
4. Mounting: Flushsemirecessed or surface mounted .
5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.11 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 1. Mounting: Surface cabinet, or flush mounted unit.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.12 ADDRESSABLE INTERFACE DEVICE

- A. General:
 1. Include address-setting means on the module.
 2. Store an internal identifying code for control panel use to identify the module type.
 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to circuit-breaker shunt trip for power shutdown
 1. Allow the control panel to switch the relay contacts on command.

2. Have a minimum of one normally open and one normally closed contacts available for field wiring.

D. Control Module:

1. Operate notification devices.
2. Operate solenoids for use in sprinkler service.

2.13 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 1. Verification that both telephone lines are available.
 2. Programming device.
 3. LED display.
 4. Manual test report function and manual transmission clear indication.
 5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
 1. Address of the alarm-initiating device.
 2. Address of the supervisory signal.
 3. Address of the trouble-initiating device.
 4. Loss of ac supply.
 5. Loss of power.
 6. Low battery.
 7. Abnormal test signal.
 8. Communication bus failure.
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.14 NETWORK COMMUNICATIONS

- A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.
- B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

2.15 SYSTEM PRINTER

- A. Printer shall be listed and labeled as an integral part of fire-alarm system.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
 2. Mount manual fire-alarm box on a background of a contrasting color.
 3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- D. Smoke- or Heat-Detector Spacing:
1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 3. Smooth ceiling spacing shall not exceed 30 feet (9 m)
 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A [or Annex B]in NFPA 72.
 5. HVAC: Locate detectors not closer than 36 inches (910 mm) from air-supply diffuser or return-air opening.
 6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
- E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.
1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- G. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- H. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- I. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.
- K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS & CABLING

- A. Networked fire alarm system shall utilize the following for pathways and cabling:
 - 1. Conduits shall not be utilized for fire alarm system.
 - 2. Cable requirements:
 - a. Minimum 18AWG for SLC and network cabling.
 - b. Minimum 14AWG for notification.
 - c. Comply with requirements of NFPA 70/760
- B.

3.4 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated HVAC duct systems.
 - 2. Magnetically held-open doors.
 - 3. Electronically locked doors and access gates.
 - 4. Alarm-initiating connection to activate emergency lighting control.
 - 5. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - 6. Supervisory connections at valve supervisory switches.
- C. Splicing of cabling is not approved.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authority having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
- D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 - 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Contracting Officer to schedule access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train NPS maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Protecting existing trees, shrubs, groundcovers, plants, grass, and other vegetation to remain or as designated by the Contracting Officer in pre-construction conference.
2. Removing existing trees, shrubs, groundcovers, plants, grass, and other vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, abandoning site utilities in place, and removing site utilities.
7. Removing existing fill.

- B. Related Sections include the following:

1. Division 04 Section "Stone Restoration" for removal and salvage of improvements of historical importance.
2. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
3. Division 31 Section "Temporary Erosion and Sedimentation Control" for storm water erosion and sediment mitigation.
4. Division 32 Section "Tree Protection" for protection of trees and vegetation within the project site.

1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to be stockpiled or to remain on Government property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
- B. Record drawings, identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions. Information required may also be included in Division 1 Section "Project Record Documents."

1.6 QUALITY ASSURANCE

- A. Preconstruction Conference: Conduct conference at Project site as directed by the Contracting Officer prior to start of construction. Contractor to comply with requirements, which may also be included in Division 1 Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

- A. Cultural and Natural Resources: Contractor shall be aware of and familiar with the location of the existing cultural and natural resources that may exist within the project limits. Resources include, but are not limited to, wetland habitat, CCC era stone pathways and curbing, historical headwalls, Mission 66 items such as wood bollards and ponderosa pine trees, character defining trees, and archeological artifacts.
- B. Traffic: Minimize interference with adjoining roads, campgrounds, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct roads or other adjacent occupied or used facilities without permission from the Contracting Officer. Closures off government property, if required, shall be subject to approval by the Town of Estes Park and/or the Colorado Department of Transportation.
 - 2. Provide alternate routes around closed or obstructed traffic ways.
 - 3. Maintain access to the Aspenglen Campground and Big Horn Ranger Station.
- C. Improvements on Adjoining Property: Authority and permits for performing removal and alteration work on adjacent rights-of-way shall be obtained by Contractor.
 - 1. Do not proceed with work on adjoining property until directed in writing by the Contracting Officer.
- D. Protect improvements on Government property, unless noted otherwise.

- E. **Salvable Improvements:** Carefully remove items indicated to be salvaged and store on Government property within staging and laydown area, or where indicated by the Contracting Officer during the pre-construction conference.
 - 1. Items of historical significance shall be removed under the observation of the Government compliance personnel. Refer to Division 04 Section "Stone Restoration" for additional requirements.
 - 2. Regulatory and advisory traffic signage shall be removed and salvaged for reuse as indicated on the Civil drawings. Install temporary signage as required to maintain traffic patterns and regulations during construction and until signage is reset. Temporary signage shall be in accordance with the Manual on Uniform Traffic Control Devices (MUTCD), latest edition.
- F. **Utility Locator Service:** Notify utility locator service for area where Project is located before site clearing.
- G. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place and inspected.
- H. Restore damaged improvements to their original condition, as acceptable to the Contracting Officer.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. **Satisfactory Soil Materials:** Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving," (PART 2 – PRODUCTS).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks, survey control points, monuments, property line pins and other reference points from disturbance during construction. If disturbed or destroyed, restore or replace by a Colorado registered land surveyor at no additional cost to the Government.
- B. Provide erosion control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust from leaving project site.
- C. Locate and clearly flag trees and vegetation to remain or to be relocated. Salvage and stockpile felled limbs, branches, and trees for re-use as landscape logs in sufficient quantity to provide slope stabilization in cut/fill areas that exceed 3:1 (H:V).

- D. Protect existing site improvements to remain from damage during construction.
 - 1. Restore or replace damaged improvements to their original condition, as acceptable to the Contracting Officer.
- E. Contractor shall follow all Federal, State, and Local codes and requirements for the abandonment of the existing septic tank, discharge piping, and On-Site Wastewater Treatment Area.

3.2 TREE PROTECTION

- A. Erect and maintain temporary fencing around drip line of individual trees or around perimeter drip line of groups of trees to remain as specified in Division 32 Section "Tree Protection".
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
- D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by the Contracting Officer.
- E. Refer to Division 32 Section "Tree Protection" for additional requirements.

3.3 UTILITIES

- A. Contractor shall locate, identify, arrange for disconnect and seal or cap off utilities indicated to be removed before site clearing or trenching of new utilities.
 - 1. Verify horizontal and vertical location of existing utilities within the project site a minimum of two weeks prior to site clearing or trenching of new utilities.
 - 2. Verify that utilities indicated as abandoned have been disconnected and capped before proceeding with site clearing.
 - 3. Arrange with utility companies having jurisdiction to shut off indicated utilities.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Contracting Officer not less than five (5) days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Contracting Officer's written permission.
 - 3. Remove all existing utilities from beneath new building footprints.
 - 4. Remove existing water and sanitary sewer services to within two feet of existing buildings to remain and connect new service lateral. Confirm elevation of existing sanitary sewer services at building point of connection prior to trenching of new lateral and notify the Contracting Officer if elevation conflicts with the design elevations.

C. Cleaning Existing Gravity Storm Sewer Systems.

1. Clean and flush portions of existing storm sewer system that are identified on the drawings of all sediment, debris, and other deleterious materials that could be considered to reduce or restrict the flow of stormwater.
 - a. Excavate and remove vegetation and sediment from the existing storm sewer inlets and grates to the satisfaction of the Government.
 - b. Perform cleaning and flushing of existing systems under the observation of the Contracting Officer or his/her designated representative.
 - c. Remove sediment, debris, and other deleterious materials and prevent from leaving the project site and from being washed downstream into existing adjacent waterways.

D. Cleaning Existing Gravity Sanitary Sewer Systems.

1. As specified in Division 33 Section "Cured in Place Pipe".

E. Abandonment of Existing Sanitary Treatment Systems

1. As specified in Division 33 Section "Onsite Wastewater Treatment System".

F. Excavate for and remove underground utilities indicated to be removed.

1. Portions of existing utility systems that are to be abandoned that conflict with new utilities shall be removed. Minimum removal shall extend full width of trench. Removals are incidental to the new utility improvements.
2. Water Services, 2-inch and Smaller: The service connection shall be excavated where the corporation stop is inserted into the water main. The corporation stop shall be closed, the service tubing or piping shall be removed from the corporation stop, the threads shall be scarred in the corporation stop, and a section of the water service line at least 12 inches long shall be cut out. The curb or valve box over the curb stop shall be removed in its entirety or cut off at least 18 inches below the ground line.
3. Sanitary Services, 4-inch and Smaller: Cut service line at existing sanitary main and cap to the satisfaction of the Government. Abandon remaining portions of the service line, unless noted otherwise.
4. Electrical and Communication systems shall be as indicated on the Electrical drawings.

G. After removal of underground utilities, as indicated, properly cap and/or plug existing lines to remain in accordance with authorities having jurisdiction.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Prepare and limb landscape logs to length as specified in Division 01 Section "Temporary Erosion and Sedimentation Control. Stockpile as directed by the Contracting Officer.

3. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 4. Grind stumps and completely remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
 5. Use only hand methods for grubbing within drip line of remaining trees.
 6. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earth moving is indicated.
1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered or as determined by the contractor's Materials Testing Agency in a manner to prevent intermingling with underlying subsoil or other waste materials.
1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil and in locations approved by the Government. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
1. Limit height of topsoil stockpiles to 36 inches unless authorized in writing by the Contracting Officer.
 2. Do not stockpile topsoil within drip line of remaining trees.
 3. Dispose of excess topsoil as specified for waste material disposal.
 4. Stockpile surplus topsoil to allow for respreading a thicker layer of topsoil.

3.6 SITE IMPROVEMENTS

- A. Removal of site improvements may also be included in Division 2 Section "Selective Site Demolition" covering items of historical significance or other existing improvements not covered herein.
- B. Remove existing above and below grade improvements as indicated and as necessary to facilitate new construction.
- C. Remove slabs, paving, curbs, gutters, and aggregate base as indicated on plans.
1. Removal of existing asphalt pavements includes removal of underlying base course material down to subgrade.

2. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
 3. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.
- D. Remove existing kiosks and buildings in their entirety including foundation and utility systems.
- E. Remove existing fill as specified in Division 31 Section "Earth Moving".

3.7 ROCK BOULDERS

- A. Remove, salvage and stockpile rock boulders as indicated on the plans and when encountered during clearing operations. Stockpile boulders in a location approved by the Contracting Officer.
1. When hauling, removing, and stockpiling boulders handle in a manner that minimizes fractures, chips, and removal of lichen and moss from the boulder.
 2. Re-use of existing boulders shall be at the discretion and approval of the Contracting Officer. Place salvaged boulders as indicated on the plans and in close coordination with the NPS. Boulders placed prior to approval of the NPS or Contracting Officer shall be removed and relocated as directed at no additional cost to the Government.

3.8 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Government property.
1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 311000

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SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, specification sections, apply to this section.
- B. Additional information concerning earth moving may be found on the civil drawings, or in the Project Geotechnical Report. In case of conflict between the drawings, Geotechnical Report, and the information specified herein, the more stringent requirements shall govern.
- C. Additional information concerning earth moving may be found in the geotechnical investigation report by Yeh and Associates, Inc., dated September 15, 2021. All applicable recommendations of this report shall be followed unless otherwise noted. Contractor to review geotechnical recommendations prior to the commencement of any earth moving activities. The information shown in this report is for information and it shall be the Contractor's responsibility to field verify conditions indicated as the work progresses.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing and grading subgrades for slabs-on-grade, walks, pavements, and exterior vegetated area.
 - 2. Excavating and backfilling for buildings and structures, including over-excavation of existing unsatisfactory on-site soil materials and replacement with structural fill.
 - 3. Base course for slabs-on-grade.
 - 4. Subgrade and base course for asphalt or concrete paving.
- B. Related Sections include the following:
 - 1. Division 01 Section "Archeological and Historic Resource Protection".
 - 2. Division 01, Section "Temporary Erosion and Sedimentation Control" for erosion and sedimentation control measures.
 - 3. Division 31, Section "Site Clearing" site stripping, grubbing, stripping and stockpiling topsoil, and removal of above-grade and below-grade improvements and utilities.
 - 4. Division 31, Section "Trenching and Backfilling" for excavating and backfilling of utilities.
 - 5. Division 33, Section "Onsite Wastewater Treatment System".
 - 6. Division 33, Section "Subdrainage" for drainage of utility trenches and walls.

C. References:

1. Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, current edition and all appropriate standard special provisions.
2. Architectural Barriers Act Accessibility Standard - ABAAS as provided for in the regulations of the United States Access Board
3. American National Standards Institute (ANSI) - *ANSI A117.1*

D. Permits and Fees: Obtain and pay for all permits and fees required for the work of this section, including Section 404, erosion and sediment control, and water quality permits required by the U.S. Army Corps of Engineers and the Colorado Department of Public Health and Environment, Water Quality Control Division.

1.3 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Bedding course placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subgrade and hot-mix asphalt or concrete paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill that has been tested by the contractor's materials testing and inspection agency and approved by the Contracting Officer.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of all material of various characteristics required for the work encountered above subgrade elevations and to lines and dimensions indicated, including boulders. See Section 3.4 "EXCAVATION, GENERAL" for definition of unclassified and classified excavation.

G. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions, as directed or approved by the Contracting Officer and the contractor's materials testing and inspection agency to correct unsatisfactory conditions. Authorized additional excavation and replacement material will be paid for according to contract provisions for changes in the work.

H. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by the Contracting Officer. Unauthorized excavation, including disposition of over-excavated materials and other work resulting from slides, cave-ins, swelling, upheaval, or remedial work, as well as remedial work directed by the Contracting Officer, shall be without additional compensation.

- I. Fill: Fill is all material placed to raise the grade of the site or to backfill excavation, upon which the contractor's materials testing and inspection agency has made sufficient tests and observations to enable him/her to issue a written statement that, in his/her opinion, the fill has been placed and compacted in accordance with the requirements of these specifications.
- J. Geotechnical Engineer: A licensed professional engineer in the State of Colorado who specializes in earth sciences and geotechnical engineering that is hired and paid for by the Contractor.
- K. Structural Fill: Select granular material for use below floor slabs and to 5 feet beyond the building lines. On-site material may be used if approved by the contractor's materials testing and inspection agency.
- L. Underslab Gravel: Imported Class 6 road base per Colorado Department of Transportation Standard Specifications for Road and Bridge Construction (current addition) or material approved by the contractor's materials testing and inspection agency.
- M. Rock Excavation: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 3/4 cu. yd. for footing, trench, and pit excavation which in the contractor's Geotechnical Engineer's opinion cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 18,650 lbf; measured according to SAE J-1179.
- N. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- O. Base Course: Course placed between the subgrade and hot-mix asphalt pavement, or course placed between the subgrade and a concrete pavement or a concrete walk.
- P. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- Q. Utilities: Include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

- A. Material Test Reports: Provided by the Contractor from a qualified, independent materials testing and inspection agency indicating and interpreting test results for compliance of the following with requirements indicated:
 - 1. Classification according to ASTM D2487 of each on-site or borrow soil material proposed for fill and backfill.

2. Laboratory compaction curve according to ASTM D698 for each on-site or borrow soil material proposed for fill and backfill.

1.5 QUALITY ASSURANCE

- A. Comply with applicable codes, ordinances, regulations, references, and standards in effect at bid date:
 1. Uniform Building Code (UBC) or International Building Code (IBC) per jurisdiction criteria.
 2. American Society for Testing and Materials (test methods as specified hereafter) (ASTM).
 3. State and local codes.
- B. In case of conflict between the above codes, regulations, references and standards, and these specifications, the more stringent requirements shall govern.
- C. Testing Agency: The Contractor will employ a qualified, independent materials testing and inspection agency. The Contractor shall furnish testing agency access to work, facilities and incidental labor required for testing. Notify the testing and inspection agency not less than 48 hours in advance of all work requiring testing.
- D. Geotechnical Engineer: All materials and operations under this section of the specifications shall be executed under the supervision of a Geotechnical Engineer, hired and paid for by the Contractor, who will place qualified personnel on the site during earth moving operations as necessary.

The Geotechnical Engineer shall observe all foundation excavations, pavement over-excavation, and subgrade preparation and give written approval of the completed work to the Contracting Officer at the following times:

1. When excavations are first open.
 2. During over-excavation operations the Geotechnical Engineer shall observe the removal, processing, moisture conditioning, and compaction of materials back to the subgrade elevation.
 3. Just prior to placing of concrete for foundations, or placement of asphalt and concrete pavements, the Geotechnical Engineer shall inspect the subgrade, test and control the fill compaction, approve the materials and method of placing and compacting and give written approval to the Contracting Officer that all bearing surfaces and fill requirements have been inspected.
 4. The Contractor shall be responsible to notify the Geotechnical Engineer when tests are to be made.
- E. For approval of imported or on-site fill material, notify the Geotechnical Engineer at least five working days in advance of intention to import material, designate the proposed borrow area, and permit the Geotechnical Engineer to sample, as necessary, from the borrow area for the purpose of making acceptance tests to prove the quality of the material. The Geotechnical Engineer report on the acceptability shall be final and binding. All material imported to the site prior to testing that does not satisfy the requirements herein shall be removed by the Contractor at no additional cost to the Government.

F. Reference Standards:

Compaction Standard: Standard Proctor Density ASTM D698.

G. Preconstruction Conference: Conduct conference at Project site as directed by the Contracting Officer prior to start of construction. The Contractor is to comply with requirements, which may also be included in Division 1, Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

A. Historical Preservation: Except by specific written authorization, protect all existing site improvements deemed to be of historical significance. Disturbance of historical stone paths, walls, and related infrastructure shall be subject to approval by the Contracting Officer and shall be restored as indicated in the Contract Documents. Contractor is responsible for notifying the Contracting Officer a minimum of two (2) weeks prior to disturbance of said historic elements.

B. Existing Utilities: Locations, sizes and depths, or invert elevations of existing utilities, as shown on the drawings, are based on information provided by others and believed to be correct but may not be absolutely so. Such information is therefore presented only as approximations and should be verified a minimum of two weeks prior to construction. Protect from damage any sewer, water, gas, electric, phone, or other pipe lines or conduits uncovered during the work until they have been examined by the Contracting Officer. If such lines are found to be abandoned and not in use, remove affected sections without extra cost. If such lines are found to be in use, carefully protect and carry on work around them. If the Contracting Officer deems it advisable to move such lines, the Government will pay cost of moving. Do not interrupt utilities serving facilities occupied by the Government or others unless permitted in writing by the Contracting Officer and then only after arranging to provide temporary utility services according to requirements indicated.

1. Contact utility-locator service for area where project is located before excavating.
2. Notify the Contracting Officer not less than five working days in advance of proposed utility interruptions.
3. Do not proceed with utility interruptions without the Contracting Officer's written permission.

C. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with the Government or private utility companies to shut off services if lines are active.

D. Remove all existing fill deemed by the Geotechnical Engineer to be unsatisfactorily placed.

E. Existing Contours and Elevations: Contours and spot elevations of existing ground elevations at the site, and approximate elevations of finish-grade cuts, fills, and excavations for the work are shown on the drawings. Contours and elevations for existing ground lines are believed to be correct, but may not be absolutely so. Existing contours and elevations should therefore be considered approximate and should be verified at the site prior to construction.

F. Verification of Existing Conditions: Visit the site prior to submission of bids. Verify existing conditions, elevations, and contours. In the event of discrepancies between existing conditions

and those indicated on the contract documents or survey, contact the Contracting Officer for clarification.

- G. Existing Benchmarks: Carefully preserve and maintain existing benchmarks, monuments, property line pins, and other reference points. If disturbed or destroyed, restore or replace by a Colorado registered professional land surveyor at no additional cost to the Government.
- H. Frost Protection: When freezing temperatures may be expected, do not excavate to the full depth indicated unless the footing or slabs are to be poured immediately after the excavation has been completed. If placing of concrete is delayed, protect the bottoms of excavations from frost until concrete is placed.

1.7 PROTECTION

- A. Park Resources: Limit damage and impacts to natural and cultural resources within the project limits and as directed by the Contracting Officer. Coordinate with the Contracting Officer and his/her compliance resource staff prior to construction activities within undisturbed areas to mitigate impacts from equipment, materials storage, and other construction activities. Contractor shall clarify at the time of bid limitations on construction activities and equipment that can be used to perform the work within the project limits.
- B. Barricades and Safety Provisions: Place and maintain until completion of work adequate barricades, construction signs, warning lights and guards to avoid property damage and to protect persons from injury. Flares with open flames will not be permitted. Protect all materials, equipment, pipe, and earth piles that may serve as hazards to vehicular or pedestrian traffic by barricades or guards and warning lights.

1.8 WARRANTY

- A. Settlement in backfill, fill, or in structures built over backfill or fill, which may occur within the specified project warranty period, shall be corrected at no additional cost to the Government. Any structures damaged by settlement shall be restored to their original condition by the Contractor, at no additional cost to the Government.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Soil materials for Onsite Wastewater Treatment systems shall be as specified in Division 33, Section "Onsite Wastewater Treatment System".
- C. Satisfactory Soils: Shall meet approval of the Geotechnical Engineer and shall be free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other

deleterious matter. Clean, on-site, cohesionless soils, or imported materials, as approved by the contractor's Geotechnical Engineer.

- D. Unsatisfactory Soils: Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups, as identified by the Geotechnical Engineer.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- E. Fill: Satisfactory, cohesionless soils, or imported materials, as approved by the contractor's Geotechnical Engineer.
- F. Retaining Wall Backfill: Satisfactory, on-site silty sand and gravel. Imported materials, as approved by the contractor's Geotechnical Engineer, shall meet the gradation limits below.

(AASHTO T27 & AASHTO T11)	
<u>Nominal Size</u>	<u>Percent Passing by Weight</u>
4"	100
No. 40	0-60
No. 200	0-15

- G. Structural Fill: Class 6 Aggregate Base Course as specified in Section 703 of the CDOT Specifications.
- H. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand, satisfying the quality and gradation requirements of Class 6 Aggregate Base Course as specified in Section 703 of the CDOT Specifications.
- I. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 15 percent passing a No. 200 sieve. Onsite, satisfactory, cohesionless soils are suitable for engineered fill provided they are tested and inspected by the contractor's Geotechnical Engineer.
- J. Bedding Course: As specified in Division 31 Section "Trenching and Backfilling".
- K. Drainage Gravel: As specified in Division 33 Section "Subdrainage".
- L. Sand: ASTM C33; fine aggregate, natural, or manufactured sand.

2.2 GEOTEXTILES

- A. Subsurface Drainage and Separation Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M288. Utilize Mirafi 140N or as recommended by the contractor's Geotechnical Engineer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Preparation of subgrade for earth moving operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface may also be specified in Division 31, Section "Site Clearing."
- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 01, Section "Temporary Erosion and Sediment Control," during earth moving operations. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil bearing water runoff or airborne dust to adjacent properties and rights-of-way.
- D. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials, as necessary.
- E. Cold Weather Work: Prevent frost from entering bearing stratus upon which construction will take place or in areas where fill will be placed in that season.

3.2 DEWATERING

- A. Prevent surface water and subsurface ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
 - 1. Additional provisions for dewatering are also specified in Division 31 Section "Dewatering".
 - 2. Dewatering shall be executed under the conditions set by the U.S. Army Corps of Engineers and in accordance with the requirements of the issued Nationwide Permit.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - 2. Install a dewatering system to keep subgrades dry and convey groundwater away from excavations. Maintain until dewatering is no longer required.
 - 3. Obtain and comply with all provisions of the Colorado Department of Public Health and Environment, Water Quality Control Division, Construction Dewatering Permit.
- C. Protection of Persons and Property:
 - 1. Provide all necessary measures to protect workmen and passersby. Barricade open excavations occurring as part of the work, as required by the Contracting Officer or other authorities having jurisdiction.

2. Protect adjacent streets, roadways, and properties throughout the entire operation. Protect newly graded areas from destruction by weather or runoff. Protect structures, utilities, sidewalks, pavements, and other improvements from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: All excavation (other than rock excavation) is considered as unclassified and is defined as removal of all material encountered, regardless of soil type. Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include soil materials, and obstructions. Unclassified excavation is considered normal excavation and no extra costs will be allowed.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove material of every nature or description encountered in obtaining required lines and grades. Excavate and/or place and compact fill to provide for building pad elevation(s) required by drawings.
3. Excavate wide enough at foundations and retaining walls to permit erection and removal of forms, application of dampproofing or waterproofing.
4. Pitch grading around excavations to prevent water from running into excavated areas.
5. Pre-rip hardpan and soft bedrock with single-tooth ripper or other suitable equipment to facilitate excavation with conventional earth-moving equipment.
6. Bearing soils disturbed by excavating equipment must be recompact to 95 percent of maximum Standard Proctor Density (ASTM D698) prior to placing concrete.
7. Exposed areas which will receive fill once properly cleaned, shall be scarified to a minimum depth of 8 inches, conditioned to near optimum moisture content, and compacted.

- B. Stability:

1. Slope sides of excavations in compliance with OSHA requirements and local codes or ordinances. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
2. Continuously monitor cut slopes for distress. Take all necessary precautions to safeguard workers, structures, and utilities.
3. Provide all necessary shoring, sheeting, or bracing of sides of excavations required to prevent caving, erosion, and gulying. Provide underpinning of existing structures or other improvements adjacent to excavations which are subject to damage.

- C. Sloping, Shaping and Finishing:

1. Leave all slopes with roughened surfaces as they are being constructed.

2. Construct slopes to staked slope ratios but steepen or flatten randomly and intermittently to simulate the irregularity of the existing terrain. Sculpt slopes to produce irregular ledges, shelves, and planting pockets suitable for placement of topsoil and vegetation by steepening the nominal slope ratio in staggered locations. Do not exceed a permanent slope in excess of 2:1 (H:V).
 3. Leave undisturbed boulders and rock outcrops that are firmly in place and protruding from the slopes but will be more than 15 feet from the edge of finished pavement.
- D. Unanticipated Conditions: Notify the Contracting Officer immediately upon finding evidence of previous structures or filled materials which penetrate below designated excavation levels, groundwater or water-bearing strata, or other conditions which are not shown, or which cannot be reasonably assumed from existing surveys and geotechnical reports. Secure the Contracting Officer instruction before proceeding with further work in such areas.
- E. Rock Excavation: Includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction. Rock excavation in unconfined areas is defined as removal and disposal of material which in the contractor's Geotechnical Engineer's opinion, cannot be excavated without continuous and systematic drilling and blasting, or continuous use of a suitable ripper or other special equipment.
1. Unanticipated Rock Excavation: Rock excavation that is not indicated on existing surveys or which cannot be reasonably assumed from geotechnical studies of the site and which could not have been anticipated without extensive investigations. Unanticipated rock excavation shall be subject to change order procedures or previously agreed upon unit prices.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.10 feet. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
1. Excavations for Footings and Foundations: Do not disturb the bottom of excavation. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - a. Foundations shall bear upon silty sand fill or medium dense silty sand with cobbles and boulders.
 - b. Subgrade soils shall be scarified minimum 12-inches, moisture conditioned, and recompact as specified below.
 - c. Loose soils at the bottom of excavation zones or the foundation subgrade shall be compacted prior to placement of foundation systems.
 - d. If cobbles or large boulders are present at the bottom of excavation zones they shall be removed and replaced with engineered fill and compacted as specified below.
 2. Excavation Below Slab on Grade: Subgrade sandy soils below slabs on grade shall be scarified minimum 12-inches, moisture conditioned, and recompact as specified below.
 - a. If non-granular material is encountered below slabs on grade, over-excavate within the proposed footprint of the building slab-on-grade to a minimum depth of 12-inches and replace with structural fill.
 - b. Slabs on grade shall be supported on a minimum 4-inches of structural fill.

3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1-inch. Do not disturb bottom of excavations intended as bearing surfaces.
 4. Excavation for structures shall be performed under the observation of the contractor's Geotechnical Engineer.
- B. Existing man-made fill shall be removed under structures, as required by the contractor's Geotechnical Engineer.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.
- B. Over-excavate subgrade soils beneath exterior slabs and sidewalks to a minimum depth of 12 inches and replace with structural fill.
- C. Subgrade soils beneath asphalt and concrete paving shall be scarified minimum 12-inches, moisture conditioned, and recompacted as specified below.
1. Proof-roll subgrade using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction. Scarify, regrade, and recompact surface of subgrade that is pumping or deforming as required to provide true levels, and uniform slopes.
 2. Proof-rolling operations shall be performed under the observation of the contractor's Geotechnical Engineer.
- D. Existing man-made fill shall be removed under walks and pavements, as required by the contractor's Geotechnical Engineer.
- E. Refer to Division 32, Sections "Asphalt Paving" and "Concrete Paving" for additional requirements and proof-rolling procedures.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Refer to Division 31, Section "Trenching and Backfilling," for excavating and backfilling of utilities.

3.8 EXCAVATION FOR ONSITE WASTEWATER TREATMENT

- A. As specified in Division 33, Section "Onsite Wastewater Treatment System".

3.9 SUBGRADE INSPECTION

- A. Notify the Geotechnical Engineer when excavations have reached required subgrade.

- B. If the Contracting Officer and the contractor's Geotechnical Engineer determine that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Remove and replace soft areas. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Contracting Officer, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to contract provisions for changes in the work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Contracting Officer, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2,500 psi, may be used when approved by the contractor's Geotechnical Engineer. If approved by the Geotechnical Engineer, structural fill placed at 100 percent ASTM D698, 2 percent below to 1 percent above optimum moisture may be used.
 - 1. Fill unauthorized excavations under other construction or utility pipe, as directed by the Contracting Officer.

3.11 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials in approved locations without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.12 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below-finish-grade, including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.

2. Surveying locations of underground utilities for record documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
8. Acceptance of subgrade by the Geotechnical Engineer.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.13 UTILITY TRENCH BACKFILL

A. Refer to Division 31, Section "Trenching and Backfilling," for excavating and backfilling of utilities.

3.14 SOIL FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

1. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
2. In areas of fill, scarify natural soil following removal of unsatisfactory material, to a depth of 8 inches.

B. Place and compact fill material in layers to required elevations and as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under building slabs, use engineered fill or reconditioned on-site soils or imported fills of native soils, as approved by the contractor's Geotechnical Engineer.
4. Under footings and foundations, use engineered fill or reconditioned on-site soils or imported fills of native soils as approved by the contractor's Geotechnical Engineer.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.15 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to optimum or to 2 percent over optimum moisture content for low plasticity clay soils, or within 2 percent of optimum moisture content for granular soils. Refer to the geotechnical study for additional recommendations.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content beyond the tolerances described above and is too wet to compact to specified dry unit weight.

3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698:
 1. Under exterior flatwork, slabs, and pavements, compact subgrade soil material at 95 percent.
 2. Under footings and interior floor slabs, compact subgrade soil to 95 percent.
 3. Under unpaved areas, scarify and recompact top 6 inches below-subgrade and compact each layer of backfill or fill soil material at 90 percent.
 4. Compact foundation wall backfill to 95 percent.
 5. Compact scarified subgrade soils to 95 percent.
 6. Compact retaining wall backfill to 95 percent.

3.17 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Grading tolerances identified herein apply to non-accessible routes, unless within this paragraph or specifically stated. Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 1. Lawn or Unpaved Areas: Plus or minus 0.10 feet.
 2. Walks: Plus or minus 0.10 feet.
 3. Pavements: Plus or minus 0.10 feet.
 4. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

Accessible Routes: For accessible routes, finished construction of accessible areas to meet published values for dimension and slope. No tolerance is permitted below minimum or above maximum values and must meet accessible requirements such as ABAAS and ANSI A117.1 and as provided for in regulations of the United States Access Board. All construction or alterations

of accessibility routes (walks, ramps, entrances, etc.) shall comply with standards, rules and regulations set forth above, including but not limited to 5% maximum longitudinal grade on walks without handrails, 8.33% maximum longitudinal grade on walks with handrails, and landings 2% maximum composite slope. 2% maximum cross slope on walks, and 2% maximum composite slope in handicap parking/loading areas. No tolerance regarding maximum slope will be allowed.

Prior to construction, contractor shall coordinate as necessary with the Contracting Officer or designated official if rules and regulations of accessibility routes cannot be met or a discrepancy of requirements are indicated on drawings.

3.18 BASE COURSES

- A. Place base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place base course under pavements and walks as follows:
 - 1. Install separation geotextile, if recommended by the Geotechnical Engineer, on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place base course material over subgrade under hot-mix asphalt or concrete pavement.
 - 3. Shape base course to required crown elevations and cross-slope grades.
 - 4. Place base course 6 inches or less in compacted thickness in a single layer.
 - 5. Place base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 6. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
- C. Pavement Shoulders: Place shoulders along edges of base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each base layer to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.19 FIELD QUALITY CONTROL

- A. Testing Agency: The Contractor will engage a qualified, independent materials testing and inspection agency to perform field quality-control testing.
- B. Allow the testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test the results for the previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by the Contracting Officer.

- D. Testing agency will test compaction of soils in place according to ASTM D1557, ASTM D2167, and ASTM D 2937, as applicable. Perform field moisture tests in accordance with ASTM D6031. Tests will be performed at the following locations and frequencies at a minimum:
 - 1. Sidewalks, Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 1,000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 50 feet or less of wall length, but no fewer than two tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by the Contracting Officer; reshape and recompact.
- C. Where settling occurs before the Project correction period elapses, remove finished surfacing and backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
- D. Install erosion control blankets and landscape logs on all disturbed surfaces that have a slope of 3:1 (H:V) or steeper. Coordinate landscape log installation with the Contracting Officer prior to implementation.
 - 1. Slopes greater than 3:1 (H:V) or greater require a minimum 6-inches topsoil placed following grading activities. Seed and cover with erosion control blankets or other approved means of temporary stabilization.
- E. Refer to Division 01 Section “Temporary Erosion and Sedimentation Control” for additional requirements for permanent stabilization on cut and fill slopes.

3.21 RESTORATION

- A. Restore historic trails disturbed during construction of the onsite wastewater treatment system and associated underground piping. Restoration shall be approved by the Contracting Officer and

shall be performed as indicated in Division 01 Sections “Archeological and Historic Resource Protection” and “Historic Preservation Treatment Procedures”.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Government’s property.

END OF SECTION 312000

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SECTION 31 23 16 – TOPSOIL

PART ONE – GENERAL

1.1 SUMMARY

- A. This section includes the following: furnishing, stripping, stockpiling and placing topsoil on a previously prepared subgrade.

1.2 RELATED WORK

- A. Section 31 10 00 - Site Clearing
- B. Section 31 20 00 - Earth Moving

1.3 QUALITY ASSURANCE

- A. Submit soil analysis report for imported topsoil from the State University Agricultural Extension Service or other approved soil testing laboratory. Report shall cover soil textural classification (percentages of sand, silt, and clay), pH, % organic matter, and soluble salts (electric conductivity in millimos/centimeter), and shall include additive recommendations. Testing will be at the expense of the Contractor.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver or place topsoil in frozen, wet, or muddy condition.

1.5 SUBMITTALS

- A. Sources: Submit name and address of sources for imported soil materials. Sources must be on Government approved list of Quarries, Borrow Pits and Other Material Sources.
- B. Delivery Tickets: Submit delivery tickets to CO on a daily basis upon delivery of these materials:
 - 1. Manufactured Topsoil

PART TWO - PRODUCTS

2.1 ON-SITE TOPSOIL

- A. On-Site Topsoil - Topsoil limits shall be the top six (6) inches of soil within the limits of the area to be disturbed by the Work. If sufficient Topsoil does not occur on site, on-site topsoil can include on-site surface soil. Remove and stockpile sufficient topsoil to allow replacement on all planted surfaces to a minimum depth of six (6) inches after natural settlement. A minimum depth of twelve (12) inches after natural settlement is required in areas of road removal. The Contractor shall protect placed topsoil from undue compaction for the duration of construction.

2.2 MANUFACTURED TOPSOIL

- A. If there is a shortage of topsoil remaining from site clearing, notify the CO, who will consult with the Park for an acceptable source of additional material located outside the park. Provide notice of at least 1 month before topsoil needs to be applied.
- B. Furnish fertile, friable, free draining, sandy loam soil that is free of subsoil, refuse, stumps, roots, brush, weeds, rocks larger than 1 inch, or other substances detrimental to the development of vegetative growth. Soil shall contain yard waste or other vegetation based additives for composting. Composted topsoil made with animal manures must meet salt concentration levels listed below.
1. Texture

(a) Organic Matter, AASHTO T 267	3 to 10%	5 - 10% to increase fertility
(b) Sand, AASHTO T 88	60 to 80%	60 to 80%
(c) Silt, AASHTO T 88	10 to 40%	10 to 40%
(d) Clay, AASHTO T 88	5 to 18%	10 - 18% to increase moisture
 2. pH, AASHTO T 289 5 to 7 6 to 7.5 at minimal impact
 3. Salts EC (Salt Concentration) 4dS/m or less 3 dS/m or less if possible

PART 3 – EXECUTION

3.1 EXAMINATION:

- A. General: Verify that existing site conditions are as specified and indicated before beginning work under this Section.
1. Grades: Inspect to verify rough grading is within +/- 0.1 foot of grades indicated and specified.
 2. Damaged Earth: Inspect to verify that earth rendered unfit to receive planting due to concrete, water, mortar, limewater or any other contaminant dumped on it has been removed and replaced with clean earth from a source approved by the CO.
- B. Surface Grade: Remove weeds, debris, clods and rocks larger than 8". Dispose of accumulated debris at direction of the CO.
- C. Runoff: Take measures and furnish equipment and labor necessary to control the flow, drainage, and accumulation of water. Ensure that all water will run off grades.

3.2 TOP SOIL HARVEST

- A. On-site Topsoil Harvest
1. Topsoil shall be harvested including all duff (dead and decaying surface plant matter), all live vegetation less than 3 feet high and less than 1 inch stem diameter, and the underlying mineral soil horizons. Depth of topsoil ranges between 2 to 24 inches with most areas having 6 to 10 inches. The topsoil

shall be harvested to the depths indicated by either 1) common fine plant roots (1/16 to 1/8 inch) or 2) dark colored soil material comprising the A or B horizons or 3) to the depth indicated by the CO in areas of deeper soils such as swales or drainages.

2. All stones >10 inches and large woody debris > 1 inch diameter shall be removed during topsoil harvest. If stumps are to be left in place, trees should be flush cut to ground level. Designated trees and snags once cut shall be removed in such a manner as to minimize damage to adjacent trees and vegetation. Surface boulders that will remain on the site following construction shall be carefully stockpiled to protect natural lichen growth. Boulders will be replaced in their natural position (i.e., partially buried with lichen facing up, etc.).
3. Limits of topsoil stripping shall be verified with the Contracting Officer prior to removal, and stockpile locations shall be identified so as not to interfere with the other work.

3.3 TOP SOIL STORAGE AND HANDLING

- A. As approved by the CO, the salvaged topsoil may be stockpiled in consolidated piles during a single growing season (not overwinter).
- B. Topsoil stockpiled overwinter shall be stockpiled in windrowed piles (no higher and wider than three by six feet) along the outer edge of the clearing limits to efficiently store and recover topsoil volume and minimize mechanical handling and loss.
- C. If possible, topsoil will be stockpiled in a disturbed area to minimize impact to adjacent vegetation at the edge of the construction footprint. If it is impractical to stockpile topsoil adjacent to the disturbed area or objectionable to the CO due to environmental or other concerns within an area, the contractor shall remove the topsoil and stockpile at an approved location. One location is approved stockpile shall not be moved.
- D. No stockpile topsoil material shall be driven on in order to avoid compaction.
- E. Salvaged topsoil shall be separated from the sub-soil and identified on each pile.
- F. Stockpiled topsoil stored for more than 6 weeks shall have erosion control sufficient to avoid sedimentary losses away from the pile by water or wind.

3.4 SOIL PREPARATION

- A. Prior to placing the topsoil, the contractor shall remove and dispose of all stumps, large clods, rocks larger than 1 foot in diameter and large roots from the graded surface where topsoil is to be applied. The contractor shall remove rocks under 1 foot in diameter that are not firmly embedded, those that protrude more than 4 inches that are not firmly embedded, and those that protrude more than 4 inches and will be within ten feet of a finished pavement surface.

- B. Prior to placing the topsoil, the contractor will disk or scarify all 3:1 slopes to a depth of 4" in a direction perpendicular to the natural flow of water and rake out obvious furrows. Slopes steeper than 3:1 shall be prepared as directed by the CO.
- C. If the CO determines that subsoil is excessively compacted by the contractor's operations, the contractor will scarify the subsoil to a depth of 24" to de-compact and break the interface between particles at no cost to the government. On steeper slopes inaccessible to tracked equipment, incorporation of topsoil can replace the disk or or scarify treatment.

3.5 PLACING TOPSOIL

- A. When applying topsoil, the contractor shall avoid mixing the harvested or stockpiled topsoil with any stored subsoil materials. The contractor shall spread conserved topsoil to a depth of at least 4 inches over all disturbed soil areas. If the conserved quantities of topsoil are not sufficient to obtain the designated depth, then the lower one-third of the embankment slopes and the least visible portions of the cut slopes may be eliminated for topsoil requirements.
- B. Remove and dispose of all stumps, large clods, rocks larger than 1 foot and large roots. Remove stones under 1 foot in diameter that are not firmly embedded and those that protrude more than 4 inches that are not firmly embedded and those that protrude more than 4 inches and will be within ten feet of a finished pavement surface.
- C. Spread topsoil using the lightest weight equipment applicable. If the CO determines that the reapplied topsoil is excessively compacted by the contractors operations, scarify the topsoil to a depth of 8 inches and break the interface between particles at no cost to the government.
- D. Do not disturb topsoil after it has been placed. As directed by the CO, to mitigate topsoil disturbed or compacted by contractor's operations, rip and decompact through the existing topsoil into the compacted sub soil to a depth of 8" to 18" depending on depth of compaction. Final slopes grade shall simulate the irregularity of the pre-existing terrain.
- E. Fine Grading
 - 1. Fine grading for all areas
 - 2. For ground surface areas surrounding buildings and hardscape, maintain required positive drainage away from buildings and hardscape
 - 3. Establish finish grades to 0.1 foot of grades indicated.
 - 4. Noxious weeds or parts thereof shall not be present in the surface grade.
 - 5. Prior to acceptance of grades, hand rake to smooth, even surface, free of debris, clods, rocks and vegetable matter greater than 8".

3.6 WEED CONTROL

- A. All stockpiles shall remain weed free.

END OF SECTION 31 23 16

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply if provided, to this Section.
- B. Additional Information may be found in the Geotechnical study by Yeh and Associates, Inc. dated September 15, 2021. All recommendations of this study shall be followed unless noted otherwise.

1.2 SUMMARY

- A. This Section includes construction dewatering.
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Facilities and Controls" for temporary utilities and support facilities may be included.
 - 2. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
 - 3. Division 33 Section "Subdrainage" for permanent foundation wall, underfloor, and footing drainage.
 - 4. Division 1 Section "Trenching and Backfilling" for excavating and backfilling of utilities.
 - 5. Division 31 Section "Temporary Erosion and Sedimentation Control" for storm water and sediment mitigation.
 - 6. Colorado Department of Public Health and Environment (CDPHE), Standards and specifications.
- C. Erosion Control: The Erosion and Sedimentation Control Drawings included in the Contract Documents is the minimum requirement to be implemented. Provide additional control as necessary to meet applicable local and State criteria.
- D. Permits and Fees: Obtain and pay for all permits and fees required for the work of this section, including Section 404, erosion and sediment control, and water quality permits required by the U.S. Army Corps of Engineers and the Colorado Department of Public Health and Environment, Water Quality Control Division.

1.3 PERFORMANCE REQUIREMENTS

- A. Temporary Diversion Performance: Temporary diversion methods are used to reroute water from a stream or restrict flows to a designated portion of the stream channel to allow for construction activities to take place in the stream, along the bank or beneath the active channel. Temporary diversion methods include temporary diversion channels, pump-arounds, piped diversions, coffer dams and other similar practices. The primary purpose of temporary diversion methods is to protect water quality by passing upstream flows around the active construction zone.

1. Bighorn Creek is a perennial stream with a relatively small tributary watershed (1.4 square miles) at the proposed construction site.
2. The proposed improvements are assumed to be a “short duration” project, anticipated to be completed within one month or less.
3. A pumped diversion is recommended based on the low baseflow, project duration, and time of year of construction.
4. It is recommended that projects involving temporary diversions be constructed between November and March.
5. Based on the project duration, time of year of construction (November – March), and the tributary watershed area, a minimum bypass flow of 0.42 cfs (189 gpm) shall be used as the design flow rate for sizing pumps.
6. If the project is constructed from April – October, a minimum bypass flow of 1.05 (473 gpm) cfs shall be used as the design flow rate for sizing pumps.
7. A backup pump (or pumps) with capacity equal to or greater than the diversion design flow rate shall be on site and in good working order at all times.

B. Dewatering Performance: Design, obtain permits, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control surface water flow into excavations and allow construction to proceed on dry, stable subgrades.

1. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
2. Prevent surface water from entering excavations by grading, dikes, pumps, or other means.
3. Accomplish dewatering without damaging existing buildings adjacent to excavation.
4. Remove dewatering system when no longer required for the project.

1.4 SUBMITTALS

A. Shop Drawings for Information: For dewatering system, show arrangement, locations, and details of headers and discharge lines, and means of discharge and disposal of water.

1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
2. Include a written report outlining control procedures to be adopted if dewatering devices fail or problems arise.
3. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.

B. Qualification Data: For installer and engineer.

C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

D. Field Test Reports: Before starting excavation, submit test results and computations demonstrating that dewatering system is capable of meeting performance requirements.

E. Copy of Permit from governing jurisdiction/agency.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with Colorado Department of Public Health and Environment (CDPHE) and all other applicable requirements of authorities having jurisdiction.
- B. Preconstruction Conference: Conduct conference at Project site as directed by Contracting Officer prior to start of construction. Contractor to comply with requirements, which may also be included in Division 1 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted in writing by the Contracting Officer and then only after arranging to provide temporary utility services according to requirements indicated by the Contracting Officer.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of the geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Government will not be responsible for interpretations or conclusions drawn from this data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
- C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
 - 1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify the Contracting Officer if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent improvements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

- B. Install dewatering and diversion systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Contracting Officer and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

3.2 INSTALLATION

- A. Install dewatering and temporary diversion systems utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
- B. Before excavating place system into operation. Operate system continuously until culverts have been constructed and fill materials have been placed, or until dewatering is no longer required.
- C. Provide an adequate system to control surface water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, culverts, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
- D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
- E. Dispose of water removed by dewatering according to local and State construction dewatering criteria and in a manner that avoids endangering public health, property, waters of State interest, and portions of work under construction or completed. Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction. Disposal of water shall meet all requirements of the dewatering permit from governing agencies.
- F. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to the Government.
 - 1. Remove dewatering system from Project site upon completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.
- G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.3 OBSERVATION WELLS

- A. Provide measurements and maintain at least the minimum number of observation wells or piezometers indicated on the shop drawings and additional observation wells as may be required by authorities having jurisdiction.
- B. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
- C. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. Suspend construction activities in areas where observation wells are not functioning properly until reliable observations can be made. Add or remove water from observation well risers to demonstrate that observation wells are functioning properly.
 - 1. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

END OF SECTION 312319

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SECTION 312333 - TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Additional information concerning trenching and backfilling may be found on the civil drawings. In case of conflict between the drawings and the information specified herein, the more stringent requirements shall govern.
- C. Additional information concerning earthwork may be found in the geotechnical investigation report by Yeh and Associates, Inc. dated September 15, 2021. The recommendations provided in this report shall be followed unless noted otherwise. It shall be the Contractor's responsibility to field verify conditions indicated.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Excavating and backfilling for utility trenches.
 - 2. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.
 - 3. Excavating and backfilling within building footprints.
- B. Related Sections include the following:
 - 1. Division 01 Section "Archeological and Historic Resource Protection".
 - 2. Division 01 Section "Historic Preservation Treatment Procedures".
 - 3. Division 01 Section "Temporary Erosion and Sedimentation Control" for erosion and sediment control.
 - 4. Divisions 22, 23 and 26 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
 - 5. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
 - 6. Division 31 Section "Earth Moving" for soil materials, site excavating, filling, grading, and compaction.
 - 7. Division 31 Section "Dewatering" for temporary diversion of Big Horn Creek during utility trenching and installation.
 - 8. Division 33 Section "Water Utility Distribution Piping" for water main installation.
 - 9. Division 33 Section "Storm Utility Drainage Piping" for storm sewer system installation.
 - 10. Division 33 Section "Sanitary Utility Sewerage Piping" for sanitary sewer main installation.
 - 11. Division 33 Section "Subdrainage Systems" for drainage of utility trenches.

- C. Shoring Design: Provide the services of a professional engineer to design all shoring, bracing, and underpinning required to protect the safety of workers and integrity of adjacent existing structures or other improvements.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Bedding course placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between the subgrade and hot-mix asphalt or concrete paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as backfill. Imported materials shall be inspected, tested, and approved by the Contracting Officer or their designated representative prior to importing to project site.
- E. Unclassified Excavation: Removal of all material of various characteristics required for the work encountered above subgrade elevations and to lines and dimensions indicated, including boulders.
- F. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed or approved by the Contracting Officer and the contractor's materials testing and inspections agency to correct unsatisfactory conditions. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- G. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction or approval by the Contracting Officer. Unauthorized excavation including disposition of over-excavated materials and other work resulting from slides, cave-ins, swelling, upheaval, or remedial work, as well as remedial work directed by the Contracting Officer, shall be without additional compensation.
- H. Rock Excavation: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 18,650 lbf; measured according to SAE J-1179.
- I. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

- J. Utilities: Includes on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- K. Controlled Low Strength Material (CLSM): Controlled Low Strength Materials (CLSM) consists of a well-graded mixture of mineral aggregates, cementitious materials, water and admixtures. Other common names for CLSMs include: flowable fill, flow fill, non-shrink backfill, and controlled density fill.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of plastic warning tape.
- B. Samples: Contractor to submit representative samples of all materials proposed for use in bedding and trench backfilling operations to the Materials Testing and Inspections Agency for analysis and determination of compliance with the requirements specified herein.
- C. Material Test Reports: Provided by Contractor from a qualified, independent materials testing and inspections agency indicating and interpreting test results for compliance of the following with requirements indicated:
 - 1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
 - 2. Laboratory compaction curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill.
- D. Permits: Submit a copy of the Construction Dewatering Permit from the Colorado Department of Public Health and Environment, Water Quality Control Division.
- E. CLSM: The Contractor shall submit a mix design and test data for approval, prior to excavating the area for which CLSMs are proposed for use. All materials of this category placed without previous approval, or which do not perform as specified, will be rejected by the Government and all costs incurred for removal and replacement of these materials will be at the Contractor's expense.

1.5 QUALITY ASSURANCE

- A. Testing Agency:
 - 1. All materials testing and inspections required herein will be performed by an independent, materials testing and inspection agency employed by the Contractor.
 - 2. Notify the testing and inspection agency not less than 72 hours in advance of all work requiring testing or inspection services.
- B. Regulatory Requirements: Comply with all applicable requirements of the Occupational Safety and Health Administration and local and State rules, regulations, and ordinances concerning

shoring, bracing, or sloping of excavations and safety of workers. Safety of workers is the responsibility of the Contractor.

- C. Coordination: Coordinate scheduling and procedures for trench excavation, bedding, and backfilling with other Sections whose work relates to or is affected by this work.
- D. Pre-Construction Conference: Conduct conference at Project site as directed by the Contracting Officer prior to start of construction. Contractor to comply with requirements, which also may be included in Division 01 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

- A. Historical Preservation: Except by specific written authorization, protect all existing site improvements deemed to be of historical significance. Disturbance of historical stone paths, walls, trails, and related infrastructure shall be subject to approval by the Contracting Officer and shall be restored as indicated in the Contract Documents. Contractor is responsible for notifying the Contracting Officer a minimum of two (2) weeks prior to disturbance of said historic elements.
- B. Existing Utilities: Locations, sizes and depths or invert elevations of existing utilities as shown on the drawings are based on field surveys and information provided by others, and are believed to be correct, but may not be absolutely so. Such information is therefore presumed only as approximations and shall be verified prior to construction. Do not interrupt utilities serving facilities occupied by the Government or others unless permitted in writing by the Contracting Officer and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify the Contracting Officer not less than three (3) days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Contracting Officer's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- C. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with the Government and public utility companies to shut off services if lines are active.
- D. Existing Benchmarks: Carefully preserve and maintain existing benchmarks, monuments, property line pins, and other reference points. If disturbed or destroyed, restore or replace them by a Colorado Registered Land Surveyor at no additional cost to the Government.
- E. Verification of Existing Conditions: Visit the site prior to submission of bids. Verify existing conditions, elevations, and utility locations. In the event of discrepancies between existing conditions and those indicated on the Contract Documents or field surveys, contact the Contracting Officer for clarification.
- F. Park Resources: Limit damage and impacts to natural and cultural resources within the project limits and as directed by the Contracting Officer. Coordinate with the Contracting Officer and their compliance resource staff prior to construction activities within undisturbed areas to mitigate impacts from equipment, materials storage, and other construction activities. Contractor shall

clarify at the time of bid limitations on construction activities and equipment that can be used to perform the work within the project limits.

- G. Barricades and Safety Provisions: Place and maintain until completion of work adequate barricades, construction signs, warning lights and guards to avoid property damage and to protect persons from injury. Flares with open flames will not be permitted. Protect all materials, equipment, pipe, and earth piles that may serve as hazards to vehicular or pedestrian traffic by barricades or guards and warning lights.

1.7 WARRANTY

- A. Settlement in backfill, fill or in structures built over backfill or fill, which may occur within the specified project warranty period, shall be corrected at no cost to the Government. Any structures damaged by settlement shall be restored to their original condition by the Contractor, at no additional cost to the Government.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Utility Trench Bedding Materials:

- 1. Granular Bedding for Sanitary and Storm Sewer piping: Well graded mixture of sound mineral aggregate complying with Class 67 (Modified) gradation in accordance with the following table:

Class 67 (Modified) Gradation	
<u>Nominal Size</u>	<u>Percent Passing by Weight</u>
3/4"	90-100
3/8"	20-55
No. 4	0-10
No. 8	5-10

In the event the excavation or over-excavation for bedding is below the water table, or if soft or wet soils are encountered at the base of the excavation, remove and replace soft or unyielding soils with coarse, washed rock (3-inch minus) and minimum six inches of Class 6 aggregate base course as specified in Section 703 of the CDOT Specifications.

- 2. Granular Bedding for Water Mains and Services: Unfrozen, friable, and no clay balls, roots, organics, or other deleterious materials. Crushed material is not permitted.
 - a. Clean, well-graded, not more than 3% by weight passing a No. 200 sieve.
 - b. Natural rounded materials.

- c. Well graded mixture complying with the gradation in accordance with the following table:

<u>Nominal Size</u>	<u>Percent Passing by Weight</u>
3/8"	100
No. 200	0-3

3. Granular Bedding for Electrical, Mechanical and Communications systems: As specified in Divisions 23, 25, and 27.
4. Bedding requirements for the MEP utility trench within the entrance station area: As specified in Division 33 Section "Subdrainage".

B. Utility Trench Backfill Materials:

1. Existing soils obtained from trench excavations, including granular or aggregate base course from removed pavements, broken and pulverized claystone or claystone-sandstone bedrock may be used for backfilling trenches, provided it meets any special requirements of the Government or the contractor's materials testing and inspection agency. Bedrock must be processed and broken or pulverized so that the maximum particle or fragment size does not exceed three-inches (3-inches).
2. Backfill requirements for the MEP utility trench within the entrance station area: As specified in Division 33 Section "Subdrainage".

C. Unsuitable Utility Trench Materials: Materials unsuitable for bedding and backfilling include highly organic soils, ASTM D2487 Group PT topsoil, and soils containing roots, vegetable matter, trash, and debris.

2.2 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

A. Controlled Low Strength Material: Self compacting, flowable concrete material produced from the following:

1. Portland Cement: ASTM C 150, Type II.
2. Fly Ash: ASTM C618, Class C or F.
3. Coarse Aggregate: In accordance with the grading and quality requirements of ASTM C 33 for Size No. 57 or No. 67.
4. Fine Aggregate: In accordance with the grading and quality requirements of ASTM C33.
5. Foaming Agent: ASTM C 869.
6. Water: ASTM C94/C 94 M.
7. Air-Entraining Admixture: ASTM C 260.
8. Admixtures: Admixtures that do not contain calcium chloride and are in accordance with ASTM C 494 for concrete may be used. Admixtures shall be compatible with the cement and other admixtures.

B. Produce low-density, controlled low strength material with the following physical properties:

1. Total cementitious material: 50 to 95 lb/cy.
2. Compressive strength at 28 days: 50 to 150 psi when tested in accordance with ASTM D 4832.

3. Fly Ash by Weight: Maximum 40% of total cementitious materials.
4. Air-entrained to total air content: 4% to 8%.
5. The mix shall have a slump between 7 and 10 inches when tested in accordance with ASTM C 143.
6. Fine Aggregates: Between 50% and 60% by volume of total aggregate.
7. Maximum water-cement ration: 3.5:1.
8. Removability Modulus (RE): Maximum 1.5 when calculated by:

$$RE = \frac{W^{1.5} \times 104 \times C^{1.5}}{10^6},$$

W=unit weight in pounds per cubic foot
 C = 28 day unconfined compressive strength

2.3 ACCESSORIES

- A. Shoring and Bracing: Provide all materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross-braces, in good and serviceable condition, as required for safety and by governing authorities.
- B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
 1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green or Dark Gray: Sewer systems.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work of this Section will be performed. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

3.2 PREPARATION

- A. The Contractor will be required to conduct work so that trenches will remain open for as minimum time as feasible for the work being conducted.
 1. No trench excavation shall commence until approved compaction equipment is at the project site where excavations are to take place.
 2. For each work group consisting of trench excavator, pipe crew, backfill and compaction operators, the maximum allowable open ditch at any time is limited to 400 lineal feet.

3. Certain conditions may necessitate the closing of certain sections of trench prior to daily, weekend, or holiday closures. Trenches in excess of 75 feet in continuous length shall not be left open overnight, weekends, or holidays.
- B. Protect structures, utilities, sidewalks, pavements, stone pathways, stone retaining walls, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by trenching operations.
 - C. Preparation of subgrade for trenching operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."
 - D. Protect and maintain erosion and sedimentation controls, which are specified in Division 01 Section "Temporary Erosion and Sediment Control," during trenching operations.
 - E. Existing Utilities:
 1. General: Location of existing utilities shown on the plans are approximate only. The Contractor shall be responsible to locate all existing underground utilities in areas of the work. If utilities are to remain in place, provide protection during excavation and backfilling operations. Should uncharted or incorrectly charted piping or other utilities be encountered during excavations, consult the Contracting Officer immediately for direction. Cooperate with the Contracting Officer or public utility agency in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of the Contracting Officer at no additional cost to the Government.
 2. Active Utilities: Do not interrupt existing utilities serving facilities occupied and used by the Government or by adjacent properties, except when permitted in writing by the Contracting Officer, and then only after acceptable temporary utility services have been provided. Remove or relocate utilities only as indicated or specified.
 3. Inactive Utilities: Report inactive or abandoned utilities encountered in excavating or grading operations, and remove, plug, or cap as required. In the absence of specific requirements, plug or cap such utility lines at least 5-feet -0-inches outside new building walls, or as required by local requirements.
 4. Refer to Division 31 Section "Site Clearing" for additional requirements.
 - F. Protection of Persons and Property:
 1. Provide all necessary measures to protect workmen and passersby. Barricade open excavations occurring as part of the work, as required by the Government, or as indicated on the Civil drawings.
 2. Protect adjacent roads, structures, and other improvements from damage caused by settlement, undermining, washout, and other hazards created by trench excavations.
 3. Road excavations shall be backfilled or plated with steel trench plates at the end of each workday to allow for continuous traffic. Inspect plates at the end of each workday and daily over weekends.
 4. Trenches that will be left open for extended periods or overnight shall be fenced on all sides using safety fencing to protect employees, the public, and wildlife. Provide means of egress as required by OSHA.

- G. Protect subgrades and trench bottoms soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- H. Cold Weather Work: Prevent frost from entering bearing strata upon which construction will taken place or in areas where fill will be placed in that season.

3.3 DEWATERING

- A. Refer to Division 31 Section “Dewatering” for additional requirement to temporarily divert Big Horn Creek during construction of the RCP culvert.
- B. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- C. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations and to collection or runoff areas. Establish and maintain temporary drainage ditches and diversions away from trench excavations. Do not use trench excavations as temporary drainage ditches.
- D. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.
 - 3. Obtain and comply with all provisions of the Colorado Department of Public Health and Environment, Water Quality Control Division, Construction Dewatering Permit.

3.4 SHORING AND BRACING

- A. Provide shoring and bracing of excavations as required for safety and by governing authorities. Carry down shoring and bracing as excavation progresses. Maintain shoring and bracing in excavations regardless of time period excavations will be open.

3.5 PAVEMENT REMOVAL AND REPLACEMENT

- A. Where trenches or other utility excavations are made in existing paved areas, saw-cut pavement surface to create a clean break line. Cut pavement a minimum of 12-inches beyond trench width on each side of trench; remove and dispose of existing surface course and aggregate base course, leaving a 12-inches wide undisturbed subgrade lip on each side of trench.
- B. After trench has been backfilled and compacted, place new pavement in accordance with applicable requirements of Division 32 Sections as applicable, for Asphaltic or Portland cement concrete pavement.

3.6 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated on the drawings.
- C. The length of trench permitted to be open at any one time may be limited when, in the opinion of the Contracting Officer, such limitation is necessary for the safety and convenience of the public; however, in no case shall the length of open trench exceed 400 feet, except when the Contracting Officer provides written permission to do otherwise. All trenches and excavations left overnight shall be protected as specified by the Contracting Officer. This may include, but is not limited to: fencing, concrete barriers, additional signage or any other measures required to provide public safety.
- D. Clearance: 12 inches each side of pipe or conduit as indicated.
 - 1. Slope sides of trenches or provide shoulders in accordance with OSHA requirements.
 - 2. Continuously monitor cut slopes and trenches for distress or movement. Provide all necessary shoring and bracing required to protect the life and safety of workmen performing excavation or installing piping or conduit.
- E. Trench Bottoms: Excavate trenches a minimum of 6 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
 - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course and backfill with a 6-inches layer of crushed stone or gravel prior to installing pipe.

3.8 BEDDING OF PIPES

- A. After completion of trench excavation and before installation of piping, install not less than 6-inches of approved bedding material in trench bottom for support of pipe. Dig bell holes in bedding deep enough to provide a minimum of 2-inches clearance between the bell and bedding material. Fully support pipe on bedding material for the full length of the pipe barrel.
- B. After pipe is adjusted for line and grade, and all jointing is complete, carefully place and tamp bedding material under the haunches of the pipe and in the previously dug bell holes.

- C. Install bedding to a minimum depth of 12-inches above top of pipe or conduit prior to starting placement of compacted backfill. Lightly compact or tamp bedding material in a manner to avoid displacement of or damage to the pipe.

3.9 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials in approved locations without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 UTILITY TRENCH BACKFILL

- A. After installation of utility piping or lines have been completed, locations recorded, trash or other debris removed from excavations, and bedding placed and approved, backfill promptly as work and weather conditions permit. Do not backfill trenches until all required pipe system tests and inspections have been made, unless partial backfilling is required to restrain pipe under test pressures. Use care in backfilling to avoid damage or displacement of pipe systems.
- B. Place bedding on subgrades free of mud, frost, snow, or ice.
- C. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- D. Place and compact bedding to a height of 12 inches over the utility pipe or conduit.
 - 1. Carefully compact initial bedding under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- E. Install warning tape directly above utilities, 12 inches below finished grade, and 6 inches below subgrade under pavements and slabs.
- F. Place backfill materials in layers not more than 8-inches in loose depth for material compacted by heavy compaction equipment, and not more than 4-inches in loose depth for material compacted by hand operated tampers. Use hand held tools or compacting devices for trench backfill, until a minimum compacted thickness of 3-feet -0-inches above top of pipe is achieved. Mechanical or power compactors may be used thereafter.
- G. Before compaction, moisten or aerate each layer of backfill to specifications.
- H. Compact each layer to not less than 95% of maximum standard Proctor density (ASTM D698). Thoroughly compact by means of mechanical tampers areas which cannot be properly compacted by means of rolling equipment.

- I. Backfill to subgrade elevation shown for finish grading, topsoil placement, or paving.
- J. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
- K. Controlled Low Strength Material: Place initial backfill of controlled low strength material to a height of 12 inches (300 mm) over the pipe or conduit. Coordinate backfilling with utilities testing.
- L. Controlled Low Strength Material: Place controlled low strength material to final subgrade elevation as indicated below.
 - 1. When CLSMs are placed within the limits of Fall River Road, or they are to be covered by paving materials, the final set product must achieve a maximum indentation diameter of 3 inches prior to covering and opening the area to traffic. Penetration resistance shall be as measured by ASTM C6024, "Standard Test Method for Ball Drop on Controlled Low Strength Material to Determine Suitability for Load Application".
 - 2. CLSM must be placed in a uniform manner that will prevent voids or segregation of the backfill and shifting of pipelines, structures and appurtenances. Foreign material that falls into the trench prior to, or during placement shall be immediately removed.

3.11 SUBSURFACE DRAINAGE

- A. As specified in Division 33, Section "Subdrainage"

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will employ a qualified, independent materials testing and inspection agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Perform field moisture tests in accordance with ASTM D3017. Tests will be performed at the following locations and frequencies at a minimum:
 - 1. Trench Backfill: The density tests shall be performed during backfilling at specified depths in the trench to ensure that the required density and moisture is obtained throughout.
 - 2. For trenches less than 30-inches in depth, density tests shall be taken within 18-inches above the top of pipe or conduit and at the surface/toplift as a minimum. For trenches greater than 30-inches in depth, density tests shall be taken within 18-inches of the top of the pipe or conduit, and at 2-foot vertical intervals to the top of the trench with the final test at the surface/toplift.
 - 3. For utility mains conduct one (1) set of tests per 50 feet of linear trench at specified depths and for service lines conduct one (1) test per every service line per utility type at specified depths.

- D. When testing agency reports that backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.13 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by the Contracting Officer; reshape and recompact as specified.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
- D. Protect pipes from floatation caused by groundwater or other surface water that may enter the trench during construction. Provide adequate measures to weight or otherwise secure pipe in trench prior to placement of bedding over the top of pipe or conduit until all testing is complete and backfill operations commence.

3.14 CLEANING AND ADJUSTMENT

- A. Cleanup: Remove excess materials not required for backfilling purposes, including excess spoil material, accumulated debris, and rubbish from site. Burning of waste material is prohibited.

3.15 RESTORATION AND REHABILITATION

- A. Adjacent Improvements: Restore all improvements and drainage ditches to condition equal to or better than before work began.
- B. Rehabilitate historic trails disturbed during construction of the onsite wastewater treatment system and associated underground piping. Rehabilitation shall be approved by the Contracting Officer and shall be performed as indicated in Division 01 Sections “Archeological and Historic Resource Protection” and “Historic Preservation Treatment Procedures”.

3.16 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Government property.

END OF SECTION 312333

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SECTION 313700 - RIPRAP BOULDERS AND BEDDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The work includes excavation, grading, and installation of void-filled riprap, placed at the locations shown on the drawings. The materials to be used and the construction of such structures shall be as specified herein.

1.2 RELATED DOCUMENTS

- A. The following is a list of SPECIFICATIONS, which may be related to this section:
 1. Section 01 5713, "Temporary Erosion and Sedimentation Control"
 2. Section 31 2000, "Earth Moving"
 3. Section 31 2319, "Dewatering"
 4. Section 31 2333, "Trenching and Backfilling"
 5. Section 31 2316, "Topsoil"
 6. Section 32 9219, "Seeding"

1.3 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. T85, Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate.
 - b. T96, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - c. T103, Standard Method of Test for Soundness of Aggregates by Freezing and Thawing.
 - d. T104, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
 - e. T248, Reducing Field Samples of Aggregate Test Size.
 2. ASTM International (ASTM): ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³)).

1.4 SUBMITTALS

- A. The Contractor shall cooperate with the Government in obtaining and providing samples of all specified materials.

- B. The contractor shall provide samples of the rock as part of the submittal process prior to procurement.
- C. The source of the rock brought to the site is subject to NPS approval to mitigate exotic or invasive species.
- D. The Contractor shall submit certified laboratory test certificates for all items required in this section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. RIPRAP

- 1. Riprap used shall be the type designated on the drawings and shall conform to Table 1.

Table 1: Riprap Gradation

Riprap Designation	% Smaller Than Given Size By Weight	Intermediate Dimension (inches)	Rock d50* (inches)
Type VL	70 - 100 50 - 70 35 - 50 2 - 10	12 9 6 2	6**
Type L	70 - 100 50 - 70 35 - 50 2 - 10	15 12 9 3	9**
Type M	70 - 100 50 - 70 35 - 50 2 - 10	21 18 12 4	12**
Type H	70 - 100 50 - 70 35 - 50 2 - 10	30 24 18 6	18
Type VH	70 - 100 50 - 70 35 - 50 2 - 10	41 33 24 9	24
*d50 = Mean Particle Size **Mix VL, L and M riprap with 35% topsoil (by volume) and bury it with 4 to 6 inches of topsoil, all vibration compacted, and revegetate.			

- 2. The riprap designation and total thickness of riprap shall be as shown on the drawings. The maximum stone size shall not be larger than the thickness of the riprap.
- 3. Neither width nor thickness of a single stone of riprap shall be less than 1/3 of its length.

4. The specific gravity of the riprap shall be 2-1/5 or greater.
5. Riprap specific gravity shall be according to the bulk-saturated, surface-dry basis, in accordance with AASHTO T85.
6. The bulk density for the riprap shall be 1.3 ton/cy or greater.
7. The riprap shall have a percentage loss of not more than 40% after 500 revolutions when tested in accordance with AASHTO T96.
8. The riprap shall have a percentage loss of not more than 10% after five cycles when tested in accordance with AASHTO T104 for ledge rock using sodium sulfate.
9. The riprap shall have a percentage loss of not more than 10% after 12 cycles of freezing and thawing when tested in accordance with AASHTO T103 for ledge rock, Procedure A.
10. Rock shall be free of calcite intrusions.
11. Gradation:
 - a. Each load of riprap shall be reasonably well graded from the smallest to the largest size specified.
 - b. Stones smaller than the 2% to 10% size will not be permitted in an amount exceeding 10% by weight of each load.
 - c. Control of gradation shall be by visual inspection. However, in the event NPS determines the riprap to be unacceptable, NPS shall pick two random truckloads to be dumped and checked for gradation.
 - 1) Mechanical equipment and labor needed to assist in checking gradation shall be provided by the Contractor at no additional cost.
12. Color:
 - a. The color of the riprap shall be approved by the Government prior to delivery to the project site.
 - b. Color shall be consistent on the entire project and shall match the color of rock to be used for all other portions of the work.
 - c. Riprap shall not have any rocks that are red, pink, or white.
13. Broken concrete or asphalt pavement shall not be acceptable for use in the work.
14. Rounded riprap (river rock) is not acceptable, unless specifically designated on the drawings.

B. VOID-FILLED RIPRAP

1. Rock requirements are to comply with riprap material specifications in Paragraph A.
2. Samples of riprap and void-fill materials shall be submitted for the review and approval of the Government prior to construction.
3. Where "Void-Filled Riprap" is designated on the drawings, riprap shall be mixed with the materials and associated proportions listed in Table 3 and Table 4 to fill the voids of the riprap.
4. If specified, an alternate void-filled riprap mix that includes river cobble shall be used; this mix appears in Table 5 and Table 6.
5. Mix proportions and material gradations in Table 3 through Table 6 are approximate and are subject to adjustment by the Government. No adjustment in unit price for void-filled riprap will be allowed based on modifications to the mix proportions.

Table 2: Mix Requirements for Type M and H Void-Filled Riprap without River Cobble

Approximate Proportions (loader buckets)	Material Type	Material Description
6	Riprap	Type M or H
2	Void-fill material	7-inch minus crushed rock surge (100% passing 7-inch sieve, 80% to 100% passing 6-inch sieve, 35% to 50% passing 3-inch sieve, 10% to 20% passing 1.5-inch sieve)
1	Void-fill material	VTC (Vehicle Tracking Control) rock (crushed rock with 100% passing 4-inch sieve, 50% to 70% passing 3-inch sieve, 0% to 10% passing 2-inch sieve)
1	Void-fill material	4-inch minus pit run surge (round river rock and sand, well graded, 90% to 100% passing 4-inch sieve, 70% to 80% passing 1.5-inch sieve, 40% to 60% passing 3/8-inch sieve, 10% to 30% passing #16 sieve)
1	Void-fill material	Type II bedding
1/2 to 1	Void-fill material	Native topsoil

Note: Mix proportions and material gradations are approximate and are subject to adjustment by the Government.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Channel slope, bottom, or other areas that are to be protected with void-filled riprap shall be free of brush, trees, stumps, and other objectionable material and be graded to a smooth compacted surface as shown on the drawings.
- B. The Contractor shall excavate areas to receive riprap to the subgrade as shown on the drawings accounting for granular bedding.
- C. The Contractor shall excavate areas to receive void-filled riprap to the specified depth (bedding material is not required for void-filled riprap).
- D. Subgrade Materials:
 - 1. The subgrade materials shall be stable.
 - 2. If unsuitable materials are encountered, they shall be removed and replaced as Muck Excavation in accordance with Section 31 2300, "Excavation and Fill" for subgrade that has been excavated in undisturbed soil.
- E. Additional Compaction:
 - 1. Additional compaction shall not be required unless specified by the Government.

2. When subgrade is built up with embankment material it shall be compacted to 95% maximum density (ASTM D698).

3.2 PLACEMENT

1. For void-filled riprap, the top surface shall be covered with 4 inches of topsoil such that no rock points are protruding.
2. The final surface shall be thoroughly wetted for good compaction, smoothed and compacted by vibrating equipment; the surface shall then be hand raked to receive planting or seeding.

B. VOID-FILLED RIPRAP

1. The Government and/or Construction Inspector shall observe mixing and placing of the material.
2. Approved individual component materials of void-filled riprap mix shall be delivered to site in separate marked stockpiles. Mixing shall be accomplished using a front-end loader or other approved means to add the specified number of "loader buckets" of each material to a mixing stockpile. Ensure that each loader bucket comprises an approximately equal volume. If the loader operator is only able to fill the bucket partially full with large riprap (due to the force required to push the bucket into the pile), but uses full buckets of finer material, the mix proportions will not be correct. Avoid picking up excessive amounts of native soil from the subgrade under the stockpiled materials during the loader bucket mixing operations. The Government may reduce or eliminate the volume of topsoil added to the mixture based on the amount of native soil was incorporated during the bucket mixing operation.
3. Once all the materials have been added to the mixing stockpile in the specified proportions, thoroughly mix the pile using a loader, large track-hoe excavator, or other approved means to fill the voids of the riprap without displacing the riprap or creating pockets of finer material absent of riprap.
4. Segregation of materials shall be minimized when hauling from the stockpile to the installation location. Remixing shall occur as necessary to correct for any segregation as the material is placed.
5. The loose material shall be placed in a single lift of sufficient height such that final grade will be achieved upon compaction. Additional mixing with a track excavator shall be required after initial placement to ensure that the void-filled riprap is thoroughly mixed and no segregation or excessive amount of smaller void-fill material is present on the surface. The mixing and placement process shall result in larger riprap (D50 size or larger) flush to the top surface with faces and shapes arranged to minimize voids, and smaller material between and below larger materials.
6. If the top of the compacted material is below final grade, placement of only the smaller void-fill materials to achieve final grade will not be permitted. Additional void-filled riprap shall be added and the entire section mixed with a track excavator to eliminate the presence of smaller void-fill material on the surface.
7. Avoid segregation of materials and remix any section where the combined material consists primarily of the void-fill materials. The density and interlocking nature of riprap in the mixed material shall essentially be the same as if the riprap was placed without filling the voids. This requires care and persistence on the part of the Contractor to install the work and on the part of the Government to assure that the work is installed correctly.

8. At the direction of the Government, a 50:50 mixture of pit run and Type II bedding shall be sprinkled on the surface of the void-filled riprap and washed-in with water using a high pressure hose to fill-in small voids. This shall be done just prior to compaction of the void-filled riprap.
9. If specified as part of the cobble mix, the top dressing of cobbles shall also be mixed in on the surface of exposed sections of void-filled riprap material prior to compaction of the riprap material.
10. Compaction of the void-filled riprap shall be performed by running over the void-filled riprap with a large, heavy duty track excavator or dozer. The moisture content of the mixture shall be at optimum conditions prior to compaction and water shall be added, as necessary, at the direction of the Government. Compaction of void-filled riprap shall be reviewed and approved by the Government.
11. Where indicated on the drawings, a surface layer of 4 inches to 6 inches moist topsoil shall be placed over the void-filled riprap. The topsoil surface layer shall be compacted to approximately 85% of maximum density and within two percentage points of optimum moisture in accordance with ASTM D698. Topsoil shall be added to any areas that settle.
12. The Contractor shall install a test section of at least 100 square feet of void-filled riprap for the review and approval of the Government prior to installation of the remaining void filled-riprap.
13. Elevation tolerance for the void-filled riprap shall be 0.10 feet. Thickness of void-filled riprap shall be no less than thickness shown and no more than 2 inches greater than the thickness shown.

3.3 REJECTION OF WORK AND MATERIALS:

- A. The Government will reject placed void-filled riprap that does not conform to this section. The Contractor shall immediately remove and re-lay the void-filled riprap to conform to specifications.
- B. Void-filled riprap that does not conform to this section shall be rejected, whether delivered to the job site or placed.
- C. Rejected void-filled riprap shall be removed from the project site by the Contractor at the Contractor's expense.

END OF SECTION 313700

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Additional information concerning asphalt paving may be found on the civil drawings. In case of conflict between the drawings and the information specified herein, the more stringent requirements shall govern.
- C. Additional information concerning asphalt paving may be found in the geotechnical investigation report by Yeh and Associates, Inc, dated September 15, 2021. All applicable recommendations of this report shall be followed unless otherwise noted. It shall be the Contractor's responsibility to field verify conditions indicated.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hot-mix asphalt paving.
 - 2. Hot-mix asphalt patching.
 - 3. Asphalt surface treatments.
- B. Relate Sections include the following:
 - 1. Division 31, Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
 - 2. Division 32, Section "Pavement Markings" for pavement striping and symbols.
- C. References:
 - 1. Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, current edition and all appropriate standard special provisions.
 - 2. Architectural Barriers Act Accessibility Standard- ABAAS as provided for in the regulations of the United States Access Board
 - 3. American National Standards Institute (ANSI) - *ANSI A117.1*

1.3 DEFINITIONS

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D8 for definitions of terms.
- B. CDOT: State of Colorado Department of Transportation.

- C. CDOT Specifications: Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, current edition and all appropriate standard special provisions.

1.4 SYSTEM DESCRIPTION

- A. Provide hot-mix asphalt paving in accordance with Section 401 of the CDOT Specifications.
 - 1. Measurement and payment provisions and safety program submittals included in CDOT Specifications do not apply to this Project.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated, include technical data and tested physical and performance properties.
- B. Job-Mix Designs: For each job mix proposed for the work. Job mix shall be tested and produced within 12 months of scheduled paving operations.
- C. Material Test Reports: For each paving material. Test reports shall be current to within 12 months of scheduled paving operations.
- D. Material Certificates: For each paving material, signed by providers.

1.6 QUALITY ASSURANCE

- A. Manufacturer and Installer Qualifications:
 - 1. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance.
 - 2. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Testing Agency:
 - 1. All testing and inspections required herein will be performed by an independent materials testing and inspection agency employed by the Contractor.
 - 2. Notify the testing and inspection agency not less than 48 hours in advance of all work requiring testing or inspection services.
- C. Testing Requirements: Asphalt Paving shall be tested for gradation, asphalt content, and in-place density in accordance with CDOT Specifications, the current edition of CDOT Field Materials Manual, and local Regulatory Agency requirements, whichever are the most stringent.
- D. Preconstruction Conference: Conduct conference at Project site as directed by the Contracting Officer. The Contractor to comply with requirements, which may also be included in Division 1, Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
1. Tack Coats: Minimum surface or air temperature in the shade of 60 degrees F.
 2. Slurry Coat: Comply with weather limitations of ASTM D3910.
 3. Asphalt Base Course (Grading S, N=75): Minimum surface or air temperature in the shade of 40 degrees F and rising at time of placement.
 4. Asphalt Surface Course (Grading SX, N=75): Minimum surface or air temperature in the shade of 50 degrees F and rising at time of placement.
- B. Coordination and Scheduling:
1. Cooperate with other trades and arrange scheduling to avoid damage to other work, including grading, site utilities and piping, exterior concrete, landscaping, and irrigation systems.
 2. Before commencing pavement operations, ascertain that utility lines, site lighting and wiring, piping, curb and gutter work, general grading, and heavy trucking is complete so that such operations will not damage paving work.
 3. Mask off and protect exposed building surfaces and abutting concrete from damage or staining by tack coat and paving operations.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations meeting the requirements of the CDOT Specifications.
- B. Asphalt Concrete Aggregate: Clean, hard, durable particles of crushed stone, crushed slag, crushed gravel, or natural gravel conforming to the requirements of Subsection 703.04 of the CDOT Specifications and Grading SX and S (Table 703-4).
- C. Mineral Filler: Rock dust, slag dust, hydrated lime, hydraulic cement, or other suitable mineral material conforming to the requirements of Subsection 703.06 of the CDOT Specifications.
- D. Slurry Seal Aggregate: Crushed stone, granite, slag, limestone, chert, or other high-quality aggregate, or combination thereof. Aggregate shall have a minimum of two fractured faces, a minimum sand equivalent of 55 when tested in accordance with AASHTO T176, a maximum abrasion resistance of 25% when tested in accordance with AASHTO T96 (Grading D), and a maximum soundness value of 15% using NA2 SO4, or maximum 25% using MgSO4, when tested in accordance with AASHTO T96.

When tested in accordance with AASHTO T27 and AASTO T11, the aggregate gradation (including mineral filler) shall satisfy the following gradation.

<u>Nominal Size</u>	<u>Percent Passing by Weight</u>
1/2"	100 +/- 0
No. 4	90-100 +/- 4
No. 8	65-90 +/- 4
No. 16	45-70 +/- 3
No. 30	30-50 +/- 3
No. 50	18-30 +/- 3
No. 100	10-21 +/- 3
No. 200	5-15 +/- 2

2.2 ASPHALT MATERIALS

- A. Asphalt Cement: The asphalt cement to be used on this project shall be PG 58-28 conforming to the requirements of Subsection 702.01 of the CDOT Specifications. Asphalt cement shall satisfy the requirements of Table 702-1 and shall be on the CDOT Approved Products List.
- B. Slurry Seals: Cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application. Emulsified asphalt used in slurry seal applications shall conform to the requirements of Table 702-4 of the CDOT specifications and shall contain a minimum of 3 percent polymer, SBR latex, or natural latex by weight.
- C. Tack Coat: AASHTO M140, emulsified asphalt or AASHTO M208, cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application. Emulsified asphalt shall conform to the requirements of Table 702-2 or Table 702-3 of the CDOT Specifications prior to dilution.
- D. Water: Potable.

2.3 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes. Furnish job-mix formulas for each pavement type, conforming to the requirements of Subsection 401.02 of the CDOT Specifications. Mix aggregates and bituminous materials in accordance with the requirements of Subsection 401.15 of the CDOT Specifications. Use approved job mix formulas. Mix to comply with the following requirements:
 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located. Mixes shall have been produced within 12 months of paving operations.
 2. Gyration (N_{des}): 75
 3. Base Course: Grading S.
 4. Surface Course: Grading SX.
- B. Emulsified-Asphalt: Shall conform to AASHTO M140 or AASHTO M208 in accordance with Subsection 702.02 of the CDOT Specifications.

Slurry Seal: Submit a mix design prepared and signed by a registered professional engineer in the State of Colorado, performed by a laboratory that has experience in designing emulsified slurry seal surfacing. Compatibility of the aggregate, emulsion, mineral filler and other additives shall

be verified by the mix design. The mix design shall be produced with the same materials and gradation to be used in the job mix and shall conform to the properties below.

Test	Description	Specification
ISSA T106	Slurry Seal Consistency	--
ISSA TB-139 (for quick-set systems)	Wet Cohesion 30 minutes Min. (set) 4 hour Min. (traffic)	12 kg-cm Min. 20 kg-cm Min.
ISSA TB-139 (for quick- traffic systems)	Wet Cohesion 60 minutes Min	20 kg-cm Min.
ISSA TB-109	Excess Asphalt by LWT Sand Adhesion	50 g/ft ² Max.
ISSA TB-114	Wet Stripping 10 minutes boiling water	Pass (90% Min.)
ISSA TB-100	Wet Track Abrasion Loss One hour soak 6-Day soak	50 gm ² Max. 75 g/ft ² Max.
ISSA TB-113	Mix Time	*
Residual Asphalt	6.5% to 12.0%	---
Mineral Filler	0.5% to 2.0%	

* The mixing test and set time test shall be done to anticipate the highest temperatures expected during construction. This includes 180 seconds mix time at 77° F and 70 seconds mix time at 100° F.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is unfrozen, free of water, snow, and ice otherwise in suitable condition to support paving and imposed loads.
- B. Proof-roll subgrade using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction. Scarify, regrade, and recompact surface of subgrade that is pumping or deforming as required to provide true levels, uniform slopes, and proper total thickness of paving as required in Division 31, Section "Earth Moving."
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 gal./sq. yd. to 0.2 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.3 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch; in existing pavements.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4-inch.
 - 1. Thoroughly clean cracks and joints in existing hot-mix asphalt pavement.
 - 2. For cracks exceeding 1/4 inch in width, rout crack minimum 3/4 inch wide, maximum 2 inches, and place backer rod as necessary.
 - 3. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4-inch wide. Fill flush with surface of existing pavement and remove excess.
 - 4. Use hot-applied joint sealant to seal cracks and joints more than 1/4-inch wide. Fill flush with surface of existing pavement and remove excess.
- C. Crack Sealing
 - 1. Crack sealing will be applied to cracks where the average crack width is greater than 1/4 inch.. Cracks shall be cleaned to make a sealant reservoir to the depth of the crack or at least 3/4 inch deep. Cracks greater than 3/4 inch deep shall have backer rod. Backer rod shall be placed to seal the full-width of the crack, multiple sections may be required. Cracks shall be filled to 1/4 inch below the pavement surface to allow for installation of the micro-surfacing materials. Checking for bond shall be conducted a minimum of 24 hours after the installation of the sealant, by attempting to peel the "cooled" material from crack channel by manual methods. In areas with insufficient bond the sealant shall be removed and re-sealed, at no additional cost to the Government.
 - 2. The crack sealant material shall be applied with the nozzle in the crack channel, so that the channel is filled from the bottom up and air is not trapped beneath the material to a slightly overfilled condition and then leveled with a squeegee in a 3 inch to 4 inch width band across the crack with a thickness of 0.06 inch to 0.10 inch. After cooling, the level of the sealant shall be no more than 1/8 inch below the pavement surface. Cracks with insufficient quantity shall be re-sealed in accordance with the specification requirements, at no additional cost to the Government.
 - 3. The blotter material shall be applied immediately after finishing and in a thin layer fully covering the exposed treatment material.
 - 4. Spilled or excess material shall be removed from the pavement surface.
 - 5. If flushing solvents are utilized, the operator must ensure that they do not contaminate the sealant or filler materials.

D. Crack Filling

1. Cracks where the average crack width is greater than 1 inch and less than 4 inches shall be filled with hot asphalt concrete.
2. The depth of the mix placed maximum of 3/16 inch below the surface of the existing pavement. The crack filled area shall subsequently be crack sealed as specified above and over-banded by a minimum shall match the existing bound pavement depths and shall be compacted flush or a of 1 inch on either side of the filled crack. The finished band width shall not exceed 6 inches. For areas to receive micro-surfacing, cracks shall be filled to 1/4" below the pavement surface to allow for installation of the overlay pavement.

E. Hot-applied joint sealant being a single-component formulation complying with ASTM D6690.

1. Refer to CDOT Standard Specification, Section 702.06 for joint and crack sealant material requirements.
2. Refer to CDOT Standard Specification, Section 408.01 and Section 408.03 for joint and crack sealant installation requirements.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

C. Tack Coat: Apply uniformly to surfaces of adjacent concrete pavements, existing asphalt pavements, and lower lifts within new pavement structural section at a rate of 0.05 gal./sq/ yd. to 0.20 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated on the plans. Maximum lift thickness shall be 3 inches. Minimum lift thickness shall be 1-1/2 inches for Grading SX and 2.25 inches for Grading S.
2. Place hot-mix asphalt surface course in single lift. Maximum lift thickness shall be 2 inches.

3. Spread mix at minimum temperature of 235 degrees F per in accordance with Subsection 401.15 of the CDOT Specifications, Table 401-5.
 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 3. Offset transverse joints, in successive courses, 6 inches to 12 inches.
 4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.7 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
1. When paving surface temperature falls below 185 degrees F no further compaction effort will be permitted unless approved.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density in accordance with Subsection 401.17 of the CDOT Specifications.
 - 1. Pavement shall be compacted to a density of 92 percent to 96 percent of the maximum theoretical density, determined according to Colorado Procedure 51. Field density determination will be in accordance with Colorado Procedure 44 or Colorado Procedure 81.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/4-inch.
 - 2. Surface Course: Plus or minus 1/4-inch.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas (Construction tolerances identified herein apply to non-accessible routes, unless within this paragraph or specifically stated):
 - 1. Base Course: 1/4-inch.
 - 2. Surface Course: 3/16-inch.
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4-inch.

Accessible Routes: For accessible routes, finished construction of accessible areas to meet published values for dimension and slope. No tolerance is permitted below minimum or above maximum values and must meet accessible requirements such as ABAAS and ANSI A117.1 and as provided for in regulations of the United States Access Board. All construction or alterations of accessibility routes (walks, ramps, entrances, etc.) shall comply with standards, rules and regulations set forth above, including but not limited to 5% maximum longitudinal grade on walks

without handrails, 8.33% maximum longitudinal grade on walks with handrails, and landings 2% maximum composite slope. 2% maximum cross slope on walks, and 2% maximum composite slope in handicap parking/loading areas. No tolerance regarding maximum slope will be allowed.

Prior to construction, contractor shall coordinate as necessary with the Contracting Officer or designated official if rules and regulations of accessibility routes cannot be met or a discrepancy of requirements are indicated on drawings.

3.9 SLURRY SEAL PLACEMENT

- A. On prepared surface, spread uniformly by means of a conventional surfacing spreader box attached to the mixer and equipped to agitate and spread the material evenly throughout the box. A front seal shall be provided to ensure no loss of mixture at the road point of contact. The rear seal shall act as the final strike-off and shall be adjustable.
- B. The spreader box and rear strike-off shall be so designed and operated that a uniform consistency is achieved to produce a free flow material to the rear strike-off. A burlap drag or other approved screed may be attached to the rear of the spreader box to provide a uniform, highly textured mat. The drag pulled behind the spreader box shall not be stiffened or hardened by slurry or asphalt.
- C. Test strips shall be made by each machine and prior to construction. Test strips shall be a portion of the project. Samples of the slurry seal will be tested by the materials testing agency to verify mix consistency and proportioning. If a test strip fails, provide additional test strips at no additional cost to the Government. Any unit failing to pass the tests after the third trial will not be permitted on the project.
- D. The slurry seal shall not be applied if either the pavement or air temperature is below 50° F and falling, but may be applied when both the pavement and air temperature are above 45° F and rising. No slurry seal shall be applied when there is danger that the finished product will freeze within 24 hours. The mixture shall not be applied when weather conditions prolong opening of traffic beyond the time allowed by the Contracting Officer.
- E. The slurry seal mixture shall be of proper consistency at all times to provide an application rate required by the surface condition. The average application rate shall be 18 to 30 pounds per square yard.
- F. When required by local conditions, the surface shall be pre wetted by fogging ahead of the spreader box. The rate of application of the fog spray shall be adjusted during the day to suit temperatures, surface texture, humidity, and dryness of the pavement.
- G. No lumping, balling, or unmixed aggregate shall be permitted. No streaks, such as those caused by oversized aggregate shall be left in the finished surface.
- H. No excess buildup, uncovered areas, or unsightly appearance shall be permitted on longitudinal or transverse joints. Provide suitable width spreading equipment to produce a minimum number of longitudinal joints.
- I. The slurry seal shall possess sufficient stability so that premature breaking of the material in the spreader box does not occur. The mixture shall be homogeneous during and following mixing and spreading. The mix shall be free of excess water and emulsion and free of segregation of the

emulsion and aggregate fines from the coarser aggregate. Spraying of additional water into the spreader box or addition of excess water shall not be permitted.

- J. Areas which cannot be reached with slurry seal machines shall be surfaced using hand squeegees to provide complete and uniform coverage.

3.10 MANHOLE FRAME ADJUSTMENTS

- A. Set frames for manholes and other such units within areas to be paved to 1/4-inch minimum to 1/2-inch maximum below final grade as part of this work. Include existing frames or new frames furnished under other sections of these specifications.
- B. Set cover frames to 1/4-inch minimum and 1/2-inch maximum below surface of adjacent pavement. Surround frames set to grade with a ring of compacted asphaltic concrete base prior to paving. Place asphaltic concrete mixture up to 1-inch below top of frame, slope to grade, and compact with hand tamping. Adjust frames as required for paving.
- C. Provide temporary closures over openings until completion of rolling operations. Remove closures at completion of work.

3.11 SURFACE TREATMENTS

- A. Slurry Seals: Prior to applying slurry seal coat, clean and fill all cracks within the limits of application as specified herein.
 - 1. Apply slurry coat in a uniform thickness according to ASTM D3910 and allow to cure.
 - 2. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified independent materials testing and inspection agency to perform field tests and inspections and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested work complies with or deviates from specified requirements.
- B. Additional testing and inspecting, at the Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D3549.
- D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

- E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D979.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D1188 or ASTM D2726.
 - a. One core sample will be taken for every 350 sq. yd. or less of installed pavement, with no fewer than three cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D2950 and correlated with ASTM D1188 or ASTM D2726.

- F. Asphalt Content and Gradation. Testing agency will take sample of uncompacted paving mixtures at a minimum frequency of every 1,000 tons according to Colorado Procedure – Laboratory CPL-5120 and Colorado Procedure CP-31.

- G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements. Conforming to the specified requirements will be in accordance with Subsection 105.03 of the CDOT Specifications.

- H. Testing and inspection of the slurry seal mixture shall be performed in accordance with the following procedures.

Test Type	Test Standard	Minimum Frequency of Tests
Residue after distillation	AASHTO T 59	One test each 5,000 square yards of slurry seal
Extraction and Gradation	AASHTO T 164 AASHTO T 30	One test each 5,000 square yards of slurry seal
Application Rate		One test each 5,000 square yards of slurry seal

3.13 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from project site, and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes constructing exterior concrete paving on prepared subgrade or base course in accordance with these specifications. This work shall be in conformity with the lines, grades, thicknesses, and typical cross-sections shown on the plans for the following:

1. Roadways.
2. Curbs and gutters.
3. Sidewalks and ramps.
4. As detailed on the plans.

- B. Related Sections include the following:

1. Divisions 31, Section "Earth Moving" for subgrade preparation, grading, and subbase course.
2. Division 32, Section "Pavement Marking" for pavement striping and symbols.
3. Division 32, Section "Concrete Pavement Joint Sealants" for expansion and contraction joints.

1.3 REFERENCES

- A. Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, current edition.
- B. Architectural Barriers Act Accessibility Standard- ABAAS as provided for in the regulations of the United States Access Board
- C. American National Standards Institute (ANSI) - *ANSI A117.1*

1.4 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.
- B. CDOT: State of Colorado Department of Transportation.

- C. CDOT Specifications: Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, current edition.
- D. ADA Handbook: Americans with Disabilities Act Standards for Accessible Design, U.S. Department of Justice.
- E. ANSI A117.1: Standard for Accessible and Usable Buildings and Facilities, American National Standard Institute.
- F. Refer to ACI 301: (American Concrete Institute – Standard Specifications for Structural Concrete), for additional definitions.

1.5 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete pavement mix, and includes alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Mix shall be tested and produced within 12 months of scheduled paving operations.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials. Test reports shall be current to within 12 months of scheduled paving operations.
 - 1. Aggregates.
 - 2. Cement.
 - 3. Admixtures.
- D. Material Certificates: Signed by manufacturers certifying that each of the following materials used in the project complies with requirements:
 - 1. Cementitious materials and aggregates.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or adhesive.
 - 8. Joint fillers.
- E. Field quality-control test reports.
- F. Pavement Joint Layout Plan: Plan to show joint locations and typical dimensions for review and approval by the Contracting Officer. Joint layout plans shall be submitted for review and approval a minimum two (2) weeks prior to construction.
- G. Traffic Control Plan: Submitted to the Contracting Officer for review and approval a minimum two (2) weeks prior to implementation.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this project, and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.
 - 1. Manufacturer must be certified according to the National Ready Mix Concrete Association's (NRMCA) Plant Certification Program.
- C. Testing Agency Qualifications: An independent agency qualified according to ASTM C1077 and ASTM E329 for testing indicated, as documented according to ASTM E548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.
- E. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.
- F. Concrete Testing Service: The Contractor will engage and pay for a qualified, independent materials testing and inspection agency to perform material evaluation tests and to design concrete mixtures.
- G. Preconstruction Conference: Conduct conference at project site as directed by the Contracting Officer prior to start of construction. The Contractor is to comply with requirements, which may also be included in Division, 1 Section "Project Management and Coordination."
- H. Regulatory Requirements:
- I. Comply with the contract documents for sidewalks, curbs, ramps, gutters, and approaches or aprons, including standard dimensions, profiles, thicknesses, reinforcing, and compressive strength. In the event of conflict between the Contract Documents and these specifications, the more stringent requirements will apply.
 - 1. Accessible Routes: For accessible routes, finished construction of accessible areas to meet published values for dimension and slope. No tolerance is permitted below minimum or above maximum values and must meet accessible requirements such as ABAAS, ANSI A117.1 and as provided for in regulations of the United States Access Board. All construction or alterations of accessibility routes (walks, ramps, entrances, etc.) shall comply with standards, rules and regulations set forth above, including but not limited to 5% maximum longitudinal grade on walks without handrails, 8.33% maximum longitudinal grade on walks with handrails, and landings 2% maximum composite slope. 2% maximum cross slope on walks, and 2% maximum composite slope in handicap parking/loading areas. No tolerance regarding maximum slope will be allowed.

1.7 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular traffic as required.
- B. Coordination and Scheduling: Coordinate with other trades and arrange scheduling to avoid damage to other work, including grading, site utilities and piping, asphalt paving, landscaping, and irrigation systems.
- C. Field Measurements: Verify dimensions and existing conditions shown on the drawings by taking field measurements prior to start of work. Report discrepancies to the Contracting Officer for clarification and make minor adjustments in layout as required by field conditions and as approved by the Contracting Officer, at no additional cost to the Government.
- D. Environmental Requirements: Perform work only under suitable weather conditions. Comply with the environmental requirements of Section 3.6 for concrete placement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the work include, but are not limited to, products specified.
 - 2. Products: Subject to compliance with requirements, provide one of the products specified.
 - 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, manufacturers specified.
 - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
 - 1. Use flexible or curved forms for curves of a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Fabric: CDOT Section 709 and ASTM A497, fabricated from as-drawn steel wire into flat sheets.

- B. Epoxy Coated Reinforcement Bars: CDOT Section 709, ASTM A615, and AASHTO A775 Grade 60, deformed. Cut bars true to length with ends square and free of burrs.
- C. Epoxy Coated Joint Dowel Bars: CDOT Section 709, ASTM A615, AASHTO M254, and AASHTO A775 Grade 60, smooth, lightly greased, and precoated with wax or asphalt emulsion. Cut bars true to length with ends square and free of burrs.
- D. Epoxy Coated Tie Bars: CDOT Section 709, ASTM A615, and AASHTO A775 Grade 60, deformed. Cut bars true to length with ends square and free of burrs.
- E. Supports for Reinforcement: Chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base materials will not support chair legs.

2.4 COLORED ADMIXTURE

- A. Colored Admixture: Rockwood Industries "Davis Colors," or approved equal, color as selected by the Contracting Officer. Use for colored concrete where indicated on the landscape drawings.

2.5 EXPANSION JOINT FILLER

- A. Sealed Joints: Preformed, compressible fiber or cork filler material complying with ASTM D1751 or ASTM D1752, Type II, guaranteed compatible with expansion joint sealant materials, 1/2 inch thick, unless otherwise indicated. Provide high-impact polystyrene removable "void cap" to create 1/2-inch deep reveal for installation of sealant.
- B. Self-Sealing Joints: Preformed, compressible asphalt fiber joint filler complying with ASTM D994, 1/2 inch thick unless otherwise indicated. Do not use asphalt fiber filler in joints to receive elastomeric joint sealants.

2.6 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project.
 - 1. Portland Cement: CDOT Section 701 and ASTM C150, Type I, II, or V gray. Portland Cement shall be listed on the CDOT Approved Products List.
 - a. Fly Ash: CDOT Section 701.02 and ASTM C618, Class F. Fly Ash shall be listed on the CDOT Approved Products List.
- B. Normal-Weight Aggregates: CDOT Section 703 and ASTM C33, coarse aggregate, uniformly graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 3/4-inch nominal in conformance with the quality and gradation requirements of Section 703.02 and Table 703-1 of the CDOT Specifications.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement. Materials shall be in conformance with the quality and gradation requirements of Section 703.01 and Table 703-1 of the CDOT Specifications.
3. Do not use fine or coarse aggregates containing substances that cause spalling.

C. Water: CDOT Section 712 and ASTM C94 potable.

2.7 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain no more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures. Admixtures shall be listed on the CDOT Approved Products List.
- B. Air-Entraining Admixture: CDOT Section 711 and ASTM C260.
- C. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 1. Water-Reducing Admixture: ASTM C494, Type A.
 2. Retarding Admixture: ASTM C494, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C494, Type D.
 4. Water-Reducing and Accelerating Admixture: ASTM C494, Type E.
 5. High-Range, Water-Reducing Admixture: ASTM C494 Type F.
 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G.
 7. Plasticizing and Retarding Admixture: ASTM C1017, Type II.

2.8 FIBER REINFORCEMENT

- A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C1116, Type III, 1/2-inch to 1-1/2 inches long.

2.9 CURING MATERIALS: CDOT SECTION 711

- A. Absorptive Cover: AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq.yd. (305 g/sq.m) dry.
- B. Moisture-Retaining Cover: ASTM C171, waterproof paper, polyethylene film, or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C309, Type I, Class B.
 1. Provide material that has a maximum volatile compound (VOC) rating of 350 g/L.

- F. White Waterborne Membrane-Forming Curing Compound: ASTM C309, Type II, Class B.
 - 1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.

2.10 RELATED MATERIALS

- A. Color Pigment: ASTM C979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 - 1. Manufacturers:
 - a. Davis Colors.
 - b. Scofield, L. M. Company.
 - c. Approved equal
 - 2. Color: As selected by the Contracting Officer from manufacturer's full range and as specified on the landscape drawings.

2.11 CONCRETE MIXTURES

- A. Prepare design mixes, proportioned according to ACI 211 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
 - 1. Use a qualified independent materials testing agency for preparing and reporting proposed mix designs for the trial batch method.
 - 2. Do not use the Government's field quality-control testing agency as the independent testing agency.
- B. Proportion mixes to provide concrete with the following properties:
 - 1. Compressive Strength (28 days): 4,500 psi .
 - 2. Modulus of Rupture (28 days): Minimum 650 psi.
 - 3. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.44.
 - 4. Slump Limit: 4 inches +/- 1" (100mm).
 - 5. Minimum 520 lb. cementitious material per cubic yard. (CDOT Class P)
 - 6. Minimum 55 percent coarse aggregate No. 6 or No. 67, coarse aggregate by weight of total aggregate.
- C. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at point of placement having an air content of 4.0 percent to 8.0 percent.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to the manufacturer's written instructions.
 - 1. Use water-reducing admixture, plasticizing and retarding admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

- F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals as follows:
 - 1. Fly Ash: 20 percent to 30 percent Class F Fly Ash CDOT Section 601.02, Class P Concrete.
- G. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. Synthetic fiber shall be provided for all mix designs.
- H. Color Pigment: Add color pigment to concrete mixture according to the manufacturer's written instructions.

2.12 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94 and ASTM C116. Furnish batch certificates for each batch discharged and used in the work.

2.13 TRUNCATED DOME PANELS

- A. Unfinished, gray cast-iron, ASTM A 159, in compliance with ABAAS guidelines for detectable warning surfaces. Detectable warning surface shall be unfinished for natural patina coloring to achieve a weathering steel aesthetic. Plate body thickness must meet or exceed 0.20-inches (not including truncated domes).
 - 1. Tiles shall meet or exceed the following test criteria:
 - a. AASHTO-HS 20 Wheel Load Test (no failure)
 - b. ASTM A48: Class 35B Gray Iron
 - c. ASTM D638: Minimum tensile strength of 35,000 psi
 - d. ASTM D5420: Minimum impact resistance of 600 in-lb
 - e. ASTM C1028: Minimum slip resistance of 0.93 (dry) and 0.91 (wet).
 - f. ASTM C501-84: Minimum abrasion resistance of 88
- B. Inline pattern: The truncated dome shall measure 0.45 inch diameter at the top of the dome, 0.90 inch diameter at the base of the dome, 0.20 inch high, and 2.35 inches on center (in-line pattern) as measured on a diagonal and 1.67" as measured side by side in-line.
 - 1. Truncated dome pattern shall align properly from panel to panel.
- C. Acceptable manufacturers include "Iron Dome" by ADA Solutions, Cast Iron by TufTile, or approved equal. Stamped concrete, polymer concrete, concrete pavers, brick, or composite products are not acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subgrade surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
 - 3. Subgrade with soft spots and areas of pumping or rutting exceeding depth of 1/2-inch require correction according to requirements in Division 31, Section "Earth Moving."
- C. Subgrade shall be tested by the contractor's materials testing and inspection agency and pass required tests prior to concrete pavement placement.
- D. Proceed with concrete pavement operations only after non-conforming conditions have been corrected, subgrade is ready to receive pavement, and the Contracting Officer has agreed that non-conforming conditions have been adequately corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subgrade surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

- D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 12-inch overlap of adjacent mats.

3.5 JOINTS

- A. General: Construct/install construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
 - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
 - 2. Contractor to provide plan of joint placement for the Contracting Officer's approval. Joint placement and plan shall coincide with the contractor's sequencing and phasing of construction.
 - 3. The distance between joints shall not exceed in feet, twice the pavement thickness in inches. (i.e.: 6-inch PCC pavement to utilize maximum 12-foot joint spacing.)
- B. Transverse Doweled Joints: Provided within the entrance kiosk area under vehicular pavements.
 - 1. Provide 1.25-inch diameter dowel bars at 12-inch maximum spacing.
 - 2. Continue reinforcement across construction joints, unless otherwise indicated.
- C. Longitudinal Tied Joints: Provided within the entrance kiosk area.
 - 1. Provide No. 5 tie bars at 30-inch maximum spacing.
 - 2. Continue reinforcement across construction joints, unless otherwise indicated.
- D. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at expansion joints.
 - 1. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
 - 2. Provide longitudinal tie bars at sides of pavement strips.
- E. Expansion Joints: Form expansion joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints in pavement where indicated on contractor's jointing plan.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler no less than 1/2-inch or no more than 1 inch below finished surface for joint sealant.
 - 4. Furnish joint fillers in one-piece lengths. Where more than one length are required, lace or clip joint-filler sections together.

5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- F. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the indicated radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 3. Tied Contraction Joints: Install deformed bars and support assemblies at joints.

3.6 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subgrade surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subgrade to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Comply with ACI 301 and ACI 304R requirements and recommendations for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery to the project site.
- F. Do not add water to fresh concrete after testing.
- G. Do not add water to concrete surface during finishing operations.
- H. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- I. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

- J. Screed pavement surfaces with a straightedge and strike off.
- K. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations.
- L. Curbs and Gutters: Produce curbs and gutters to required cross section, lines, grades, finish, and jointing, as specified with expansion joints at intervals of approximately 100 feet and tooled contraction joints at 10-foot intervals. When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Curb heads within the entrance station kiosk area shall be poured monolithically with adjoining concrete pavement. Provide synthetic fiber reinforcing.
- M. Walks: Minimum 4 inches thick, with expansion joints at intervals of approximately 100 feet and tooled or sawed contraction joints at intervals equal to width of walks or maximum 5-foot intervals. Tool edges to rounded profile and finish as noted herein or shown on the drawings. The Contractor may utilize sawed contraction joints. Pitch walks 3/16-inch per foot for drainage, unless otherwise indicated. Provide synthetic fiber reinforcing.
- N. Curb Ramps: Construct ramps similar to walks. Comply with applicable ABAAS Handbook, ANSI A117.1, and details on the drawings. Install truncated dome panels with neat, clean edges and consistent width panels installed in accordance with the manufacturer's instructions. Misaligned edges and inconsistent panels shall be subject to removal at the discretion of the Contracting Officer.
- O. Paving: Minimum 8 inches thick, unless otherwise indicated. Provide expansion joints, as indicated on the Contractor's joining plan, and contraction joints at a minimum 12 feet EWW. Provide fibermesh reinforcing. Place concrete paving over compacted subgrade as specified in Division 31, Section "Earth Moving." Provide minimum 1 percent slope for drainage unless otherwise indicated.
- P. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing, as required for formed pavement.

Compact and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- Q. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.
- R. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F and not more than 80 degrees F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

- S. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is the Contractor's option.
 - 2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.
- T. Wet-Weather Placement: Do not begin to place concrete while rain, sleet, or snow is falling unless adequate protection is provided and, when required, acceptance of protection is obtained.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
- C. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Medium-to-Fine-Textured Broom Finish: For use on pedestrian areas only. Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
 - 2. Medium-to-Course-Textured Broom Finish: For use on roadways only. Provide a coarse finish by striating float-finished concrete surface 1/16-inch-deep to 1/8-inch-deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection and follow the recommendations of ACI 305R for hot-weather protection during curing.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- D. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 - 1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 PAVEMENT TOLERANCES

- A. Tolerances identified herein apply to non-accessible routes, unless within this paragraph or specifically stated. Comply with tolerances of ACI 117 and as follows:
 - 1. Elevation: 1/4-inch.
 - 2. Thickness: Plus 3/8-inch, minus 1/4-inch.
 - 3. Surface: Gap below 10-foot-long, unlevelled straightedge not to exceed 1/4-inch.
 - 4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
 - 5. Vertical Alignment of Tie Bars and Dowels: 1/4-inch.
 - 6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2-inch.
 - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4-inch per 12 inches.
 - 8. Joint Spacing: 3 inches.
 - 9. Contraction Joint Depth: Plus 1/4-inch, no minus.
 - 10. Joint Width: Plus 1/8-inch, no minus.
- B. Refer to the *Accessibility Inspection Report Form – Buildings and Facilities* as provided on the Denver Service Center website for pavement measuring device criteria associated with accessible routes. See section 1.6.I for ADA tolerance requirements.
 - 1. <https://www.nps.gov/dscw/ds-accessibility-universal-design.htm>

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage and pay for a qualified, independent materials testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each 50 cu. yd. or fraction thereof of each concrete mix placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each type of concrete mix. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C231, pressure method; one test for each composite strength test, but not less than one test for each day's pour of each type of concrete mix.
 - 4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40 degrees F and below and when 80 degrees F and above, and one test for each set of composite strength specimens.
 - 5. Compression Test Specimens: ASTM C31; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.
 - 6. Compressive-Strength Tests: ASTM C39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but less than 25 cu. yd., provide at least two tests for every 100-cu. yd., (one set for each 50-cu. yd.). One specimen shall be tested at seven days and two specimens at 28 days; one specimen shall be retained in reserve for later testing, if required.
 - 7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.
- C. Strength of each concrete mix will be satisfactory if average of any three-consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to the Contracting Officer, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both seven-day tests and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Contracting Officer, but will not be used as the sole basis for approval or rejection.
- F. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as

directed by the Contracting Officer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods, as directed.

- G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at the Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Accessible Routes: See section 1.6.I for ADA tolerance requirements. Verify accessible routes and parking spaces for compliance with ABAAS using the *Accessibility Inspection Report Form – Buildings and Facilities* as provided on the Denver Service Center website.

3.11 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this section.
- B. Drill test cores where directed by the Contracting Officer when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Additional information concerning concrete paving may be found on the civil drawings. In case of conflict between the drawings and these specifications, the more stringent requirements shall govern.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Expansion and contraction joints within cement concrete pavement.
 - 2. Joints between cement concrete and buildings and structures.
 - 3. Surface preparation including primers.
 - 4. Joint backup material.
- B. Related Sections include the following:
 - 1. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

1.3 REFERENCES

- A. Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, current edition.

1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- C. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.
- E. Warranty: As required by Division 1 – Warranty Section: Contractor agrees to repair or replace joint sealers (including labor, materials, and any necessary associated costs) which fail to perform as watertight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance or general durability; or appear to deteriorate in any other manner not clearly specified by submitted manufacturer’s data as an inherent quality of material for exposure indicated. Provide warranty signed by Installer and Contractor.

1.5 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: Work under this section shall be subject to all applicable provisions of federal, state, and local rules and regulations.
- B. Applicator: Company specializing in application of sealants with five years minimum experience and be acceptable to manufacturer. Manufacturer’s field representative shall visit site and make suggestions.
- C. Adhesion Tests: Prior to any sealant application, perform adhesion tests as directed by sealant manufacturer’s technical representative.
- D. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Install sealant materials in strict accordance with all safety and weather conditions recommended by manufacturer, product literature, or Material Safety Data Sheets. Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above manufacturer’s recommended limitations for installation. Proceed only when forecasted weather conditions are favorable for proper cure and development of high-early bond strength. Wherever joint width is affected by ambient temperature variations, install elastomeric sealants only when temperatures are in lower third of manufacturer’s recommended installation temperature range.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Contracting Officer from manufacturer's full range.

2.2 JOINT SEALANTS

- A. Single-component formulation complying with ASTM D 6690 of D1190.
 - 1. Refer to CDOT Standard Specification, Section 705.01 and 705.09 for joint and crack sealant material requirements.
 - 2. Refer to CDOT Standard Specification, Section 412.18 for joint and crack sealant installation requirements.

2.3 JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.
- D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.4 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from manufacturers recommendation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. 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.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 JOINT DESIGN

- A. Sealant depth is measured at the center (thin) section of sealant bead.
- B. Install sealants to depths and widths as recommended by sealant manufacturer and as shown on the drawings. Also, conform to the following general limitations if not in conflict with sealant manufacturer's recommendations.
 - 1. For sidewalks, pavements and similar joints subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75 percent of joint width, but neither more than 5/8 inch deep nor less than 3/8 inch deep.
 - 2. For normal moving joints not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but neither more than 5/8 inch deep nor less than 1/4 inch deep.
 - 3. Depth of sealant must not exceed width of joint.
 - 4. Sealant joints shall not be less than 1/4 inch in width and 1/4 inch in depth.
 - 5. Sealant joints shall not exceed 2 inches in width in a single application.

3.4 SURFACE PREPARATION

- A. Preparation work shall result in clean surfaces in all areas where sealant is to be adhered. Such surfaces shall be free of any old sealant, contaminants, and impurities, which are deleterious to bonding or adhesion of primers or sealant.
- B. Clean ferrous metals of all rust, mill scale, and coatings by wire brush or grinding. Any equipment used to remove rust shall be free of oil contaminants.
- C. Wire brush masonry joint surfaces, then blow clean with oil free compressed air.

- D. Apply primer per manufacturer's recommendations. Allow primer to dry prior to applying sealant.
- E. Do not caulk joints until they are clean, dry, and free of dust, loose mortar, old sealant, foreign matter or other bond inhibiting materials, and in compliance with requirements of manufacturer of materials, details shown on drawings, and specific requirements of other sections of specifications.

3.5 JOINT BACKING

- A. Use joint backing to control depth of joint to specified thickness.
- B. Select joint backing size to allow for 25 percent compression of backing when inserted into joint.
- C. Where shown on drawings where depth of joint will not permit use of joint backing, or wherever recommended by sealant manufacturer, install bond-breaker tape to prevent three (3) sided adhesion.
- D. Do not leave voids or gaps between ends of joint backing units.

3.6 APPLICATION/INSTALLATION OF JOINT SEALANT

- A. Apply sealants neatly, in a good and workmanlike manner, which meets following minimum requirements or standards. Specific instructions of manufacturer must also be followed.
- B. Apply sealant using a gun with proper size nozzles. Use sufficient pressure to fill all voids and joints solid to backup material, with complete wetting of all joint bond surfaces.
- C. Applied sealant shall form a full, smooth, uniform bead, free of ridges, wrinkles, sags, air pockets and embedded impurities.
- D. After joint has been completely filled with sealant, neatly tool joint sealant to eliminate air pockets, or voids, and to provide a smooth, slightly concave, neat appearing finish, with sealant surface slightly below adjoining surfaces. Wetting of finished surface will not be allowed.
- E. Where horizontal joints are located between a horizontal surface and vertical surface, fill joint to form a slight cove, so joint will not trap moisture and dirt.
- F. Protect adjacent surfaces and systems from sealant material. Use masking tape where required to prevent contact of sealant with adjoining surfaces which 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.
- G. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

- H. Tooling of Non-Sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealants from surfaces adjacent to joint.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- I. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.
- J. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.7 CLEANING

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

3.8 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes, so sealants 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 and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

3.9 JOB SITE CLEAN-UP

- A. Sealant applicator must remove all excess materials from job site.
- B. Leave all surrounding areas where joint sealant has been applied free of excess sealant, debris, and foreign substances.

END OF SECTION 321373

SECTION 32 14 00 - UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rubble stone paving set in aggregate setting beds at Entrance Station kiosk medians.
- B. Related Sections:
 - 1. Section 31 20 00 - Earth Moving
 - 2. Section 32 15 40 - Crusher Fines Paving
 - 3. Section 32 93 10 - Landscape Boulders

1.2 ACTION SUBMITTALS

- A. Samples for rubble stone pavers for approval.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.
- B. Mockups: Build 6' x 6' mockup of rubble stone paving to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided

1.5 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or build on frozen subgrade or setting beds.

PART 2 - PRODUCTS

2.1 STONE PAVERS

- A. Rough-Stone Pavers: Rectangular tumbled paving stones, with split natural faces and edges, made from granite complying with ASTM C 615.
 - 1. Stone Sources: Granite from local source to match existing shape, color, texture and size of other Stone Masonry (Stone Veneer) on retaining walls.
 - a. Crystal Landscape Supplies, Loveland, Colorado
 - b. Pioneer Landscape Centers, multiple Colorado locations
 - 2. Color and Grain: mixed of grays, browns and buff with medium grain
 - 3. Thickness: Sizes indicated on Drawings
 - 4. Stone shall be sound, hard, well-shaped, clean, durable, and free from structural defects and seams, iron rust, and dirt. Sorting, collection, storage and transportation of stone materials are the responsibility of the Contractor as is coordinating with the sub-contractors. Cutting, splitting, tooling and installing stone as required, is the responsibility of the contractor and sub-contractors. All chips and waste must be returned hauled off and disposed of legally as per Division 01.
 - 5. Contractor shall provide samples, shop drawings, and mock-ups as indicated on the Drawings and in this Section.

2.2 AGGREGATE SETTING-BED MATERIALS

- A. Graded Aggregate for Base: Sound, crushed stone or gravel complying with requirements in Section 312000 "Earth Moving" for base course.
- B. Crusher Fines for Joints: Fine, sharp, washed, natural crushed stone.
- C. Drainage Geotextile: Nonwoven needle-punched geotextile fabric, manufactured for subsurface

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- B. Cut unit pavers with motor-driven masonry saw equipment to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.
 - 1. For concrete pavers, a block splitter may be used.
- C. Joint Pattern: Random ashlar pattern as indicated on Drawings.
- D. Tolerances: Do not exceed 4-inch unit-to-unit offset from flush (lippage) as indicated on drawings.

3.2 AGGREGATE SETTING-BED APPLICATIONS

- A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 698 laboratory density.
- B. Place aggregate base, compact by tamping with plate vibrator, and screed to depth indicated.
- C. Place leveling course and screed to a thickness of 1 inches (25 to 38 mm), taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.
- D. Treat leveling course with herbicide to inhibit growth of grass and weeds.
- E. Set pavers with a minimum joint width of 1/8 inch and a maximum of 1/2 inch (being careful not to disturb leveling base. Revise first paragraph below for pavers installed over waterproofing if required.
- F. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf compaction force at 80 to 90 Hz.
- G. Spread crusher fines and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

END OF SECTION 32 14 00

SECTION 32 15 40 CRUSHER FINES PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for demolition, earthwork, grading, furnishing, and placement of crusher fines paving.
 - 1. Furnish and place crusher fines paving, bonded with fine aggregate, constructed in accordance with these specifications and in conformity with the dimensions, typical cross section, and the lines and grades shown on the Contract Drawings.
 - 2. The locations where crusher fines paving are as shown on the Contract Drawings.
- B. Related Sections:
 - 1. Section 31 12 00 – Earth Moving

1.2 REFERENCES

- A. ASTM C117 – Test Method for Materials Finer than No. 200 (75-um) Sieve in Mineral Aggregates by Washing.
- B. ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. ASTM D4318 – Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

1.3 SUBMITTALS

- A. Material Analysis: Contractor shall provide copies of the following test data required by ASTM:
 - 1. ASTM C136 - Sieve Analysis.
 - 2. ASTM C127 - Specific Gravity and Absorption.
 - 3. ASTM C131 - L.A. Abrasion.
- B. Samples: Provide a one (1) quart sample of material for approval.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways, and pavements, or on existing turf areas, plant materials or within critical root zones.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Rejection of material.

1. Evidence of inadequate protection or improper handling or storage shall be cause for rejection.
2. Any product or material exhibiting signs of damage due to nonconformity to specifications or due to delivery, storage or handling shall be rejected by the CO. Contractor shall be responsible for hauling off-site and disposing of according to general conditions and codes of the governing jurisdiction.

1.5 PROJECT CONDITIONS

- A. Environmental requirements: Work shall occur only when weather and soil conditions permit in accordance with locally accepted practice.
- B. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with proposed crushed stone paving areas by field measurements before proceeding with work.
- C. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by the Government or others.
- D. Existing Conditions:
 1. Utilities: Determine location of existing and proposed underground utilities. Perform work in a manner to avoid damage. Hand excavate, as required.
 2. Excavation: Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
- E. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained.

PART 2 - PRODUCTS

2.1 CRUSHER FINES PAVING

- A. Type: Crushed granite stone or gravel. Shall be unused material free of shale, lay, friable materials, organics, and debris.
 1. Size Range: 3/8 inch maximum
 - 2.

<u>Sieve Size</u>	<u>Percent Passing</u>
2 inch	100
3/8 inch	100
No. 4	85
No. 8	63
No. 16	50
No. 30	39
No. 50	29
No. 100	18

- B. Sand: Natural river or bank sand; washed, free of silt, clay, loam, friable or soluble materials, and organic matter.
- C. Color: Gray as selected by Park and CO.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where the Work of this Section will be performed for compliance with requirements and conditions affecting installation and performance.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within the work area.
 - 2. Verify that final grades are completed in accordance with the drawings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected and approved by CO.

3.2 FIELD QUALITY CONTROL

- A. Mock-up: Provide field constructed sample installation of crushed stone paving and prepared subgrade.
 - 1. Mock-up to be ten foot (10') x ten foot (10') and located where directed by CO. Mock-up shall include proposed edge and banding, and surface stabilization if specified.
 - 2. CO shall review mock up within forty-eight (48) hours of notification by the contractor.
 - 3. Make necessary adjustments as directed by CO.
 - 4. Obtain approval from CO before proceeding with the Work.
 - 5. Retain and protect mock-up during construction as a standard for judging completed crushed stone paving work. Do not remove or destroy mock-up until work is completed.
 - 6. Accepted and properly maintained sample installations may remain in completed work if approved in writing by CO.
 - 7. All work shall match accepted field mock-up.

3.3 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, turf areas, existing landscape areas, and trees from damage.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of
- C. Install edging of type and in locations shown on drawings. Obtain acceptance of layout by CO before excavating or installing. Make minor adjustments as required.

3.4 PLACEMENT OF SOFT SURFACE PAVING

- A. Cut earthwork to width of trail/area to receive crusher fines paving to approximate depth section as specified on the Contract Drawings. Remove, haul, and dispose of excess material off site, or use on-site with approval of CO.

- B. Complete excavation required in sub-grade before fine grading and final compaction of sub-grade is performed. Extend sub-grade compaction one foot (1') beyond proposed edge of crushed stone paving or as indicated on drawings.
 - 1. Where earth moving is required the sub-grade shall be compacted to ninety five percent (95%) standard proctor within two percent (2%) of the optimum moisture.
 - 2. Keep areas being graded or compacted shaped and drained during construction. Ruts greater than or equal to 1 inch deep in sub-grade shall be graded out and reshaped as required, and re-compacted before crushed stone paving placement.
 - 3. If the trail is part of a cross slope it should drain in the direction of the slope no greater than two percent (2%). Ensure that no low spots exist so that ponding does not occur.
- C. Prior to placement of Crusher Fines Paving material, the sub-grade shall be proof rolled. Where soft spots are detected, scarify subgrade beneath Crusher Fines Paving trail to a minimum of six-inch (6") depth. Moisture treat and compact to a minimum ninety five percent (95%) proctor density as determined by ASTM D698 or AASHTO T-99. Take moisture density tests every two hundred fifty (250) lineal feet of trail or proof roll. Treat and compact sub-grade, leaving it 5-inches below final grade for placement of Crushed Stone Paving. Compact material and retest by proof rolling to achieve approval of CO.
- D. Install crusher fines paving only after excavation and construction work which might injure it have been completed, and after edging has been completely installed on the compacted sub-grade. Install crushed stone paving, over compacted base course in areas indicated on plan.
- E. Spread crusher fines evenly to fifty percent (50%) of specified depth. Avoid segregation of aggregate and contamination with lower courses or sub-grade.
- F. Compact to ninety-five percent (95%) of maximum density as determined by ASTM D1557.
 - 1. Maintain surface course moisture content within plus/minus three percent ($\pm 3\%$) of optimum. Add water to quarry fines paving as required to achieve optimum moisture content and a uniform, compacted surface conforming to the finish grades indicated.
 - 2. Compact areas inaccessible to rolling by mechanical tamping.
- G. Protect crusher fines paving from soil or other contaminates during and following installation.
- H. Spread and compact additional crushed stone paving to achieve the required minimum compacted thickness per compaction requirements in this section

3.5 MAINTENANCE AND REPAIRS:

- A. Crusher Fines Paving:
 - 1. Areas that do not compact, become eroded or are degraded in visual quality and/or performance as determined by the CO are to be removed and/or repaired. Obtain approval of repair methods from CO prior to affecting repairs.

3.6 CLEANUP AND PROTECTION

- A. All areas shall be clean at the end of each workday.
- B. The contractor shall maintain protection during installation, curing, and maintenance periods.
 - 1. Erect temporary fencing or barricades and warning signs as required protecting newly installed Soft Surface Paving areas from traffic, other trades, and trespassers. Maintain

fencing and barricades throughout initial maintenance period and remove with approval of CO.

- C. Project completion: All debris, soil, trash, and excavated and/or stripped material resulting from Soft Surface Paving operations and unsuitable for or in excess of requirements for completing work of this Section shall be disposed of off-site.
- D. Maintain protection during installation and maintenance periods. See Division 01. Treat, repair, or replace damaged work as required.

3.7 QUALITY ASSURANCE

- A. Refer to Division 01.

END OF SECTION 32 15 40

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions, and Division 1 specification sections apply to this Section.

1.2 SUMMARY

- A. This Section includes the following: Furnish and install all painted lines, directional arrows, handicapped symbols, or similar markings on paved surfaces, as shown on the drawings or specified herein, as required by jurisdiction having authority, and as required to complete the work.
- B. Related Work:
 - 1. Division 32 Section "Asphaltic Paving" for materials, installation and minimum requirements.
 - 2. Division 32 Section "Concrete Paving" for materials, installation and minimum requirements.

1.3 REFERENCES

- A. Reference Standards: Comply with the requirements of the reference standards noted herein, except where more stringent requirements are described herein or otherwise required by the Contract Documents.
- B. Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, current edition.
- C. "Manual on Uniform Traffic Control Devices" latest edition.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's published descriptive literature and complete specifications for products specified herein and approved by the Contracting Officer.

1.5 QUALITY ASSURANCE

- A. Qualifications: Pavement marking applicator shall be regularly engaged in this type of work, and shall provide adequate, experienced manpower and proper equipment to complete the work.

- B. Regulatory Requirements: Comply with applicable provisions of Colorado State Department of Transportation Specification Sections 627, 708, and 713.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Packing and Shipping: Deliver materials in manufacturer's original, unopened containers, with labels intact and legible.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements: Do not apply pavement marking when ambient air and pavement surface temperature is below 40°F for paint and below 50°F for epoxy and thermoplastic marking materials, or when moisture in any form is present on the pavement surface.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Temporary Traffic Marking Paint: Acrylic Waterborne Paint or Low Volatile Organic Compound (VOC) solvent base paint, lead and chromate free, ready-mixed, cold-applied traffic marking paint complying with CDOT specification table 708-1, white or yellow color as designated on the plans for striping and lane markings, white and blue at international handicapped parking symbols. Acceptable products include Devoe Exterior "Safety Line" or approved equal.
- B. Reflective Glass Beads: Transparent, clean colorless, smooth and spherical glass beads conforming to AASHTO M-247, Type 2, Flotation Grade.
- C. Inlaid Preformed Plastic Tape Pavement Marking Material: In accordance with Section 713 of the CDOT Specifications. To be used for lane lines, edge lines, skip striping, gore striping, and related applications. Markings shall consist of a resilient white or yellow thermoplastic product with glass beads uniformly distributed. Previously approved by the CDOT Product Evaluation Process per CDOT Section 627.08, 713.13, and 713.15. Inlaid preformed plastic marking material shall be considered a Bid Option as specified in Division 1 Section "Definition of Contract Line Items".
- D. Epoxy Pavement Markings: Heated epoxy pavement marking compounds previously approved by the CDOT Product Evaluation Process per CDOT Section 627.05 and 713.17. Epoxy pavement markings shall be considered Base Bid.
- E. Inlaid Preformed Thermoplastic Pavement Marking: To be used for accessible markings, directional arrows, and related applications. Capable of being affixed to bituminous or concrete pavement by heating and applied to concrete per manufacture recommendations. Preformed thermoplastic pavement markings shall be considered Base Bid.
- F. Vinyl Film: Brown vinyl film for use on the back of proposed signs shall be a minimum of 2.5 mils and be manufactured for use outdoors in a similar environmental climate. Install per manufacture recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work of this Section will be performed. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

3.2 PREPARATION

- A. Surface Preparation: Allow fresh pavement surfaces to weather at least 30 days prior to application of traffic marking paint.

3.3 APPLICATION

- A. Temporary Traffic Marking Paint: Unless otherwise indicated, apply traffic marking paint in nominal 4-inches wide stripes at the rate of 100 to 110 sf/gal.
- B. Reflective Glass Beads: Where indicated on the drawings, mix reflective glass beads with traffic marking paint at the rate of 5 lbs 3 oz to 6 lbs 3 oz/gal.
- C. Inlaid Preformed Plastic Tape Pavement Marking:
 - 1. If recommended by the manufacturer, an epoxy resin primer conforming to CDOT Section 707.08 shall be applied to all pavement surfaces prior to the application of the preformed plastic pavement marking.
 - 2. The grooved width shall be the pavement parking width plus 1 inch, with a tolerance of plus or minus ¼ inch. The depth of the grooves shall be 130 mils plus or minus 5 mils. Groove position shall be a minimum of 2 inches from the edge of pavement marking to the longitudinal pavement joint.
 - 3. Apply per manufacturers recommendations.
- D. Epoxy Pavement Marking: Heat individual components to a temperature of 27° to 60° C (80° to 140° F). Apply to a minimum thickness of 15 mils and with an application rate of 100 to 110 sf per gallon. Apply 25 lbs of beads per gallon of epoxy material.
- E. Patterns and Symbols:
 - 1. Unless otherwise indicated, apply traffic markings in nominal 4-inches wide stripes with clear and sharp dimensions. See drawings for striping patterns, directional arrows and symbols.
 - 2. Unless otherwise indicated, use yellow markings at lane striping and directional symbols, white markings at parking striping and white and blue markings at international handicapped symbols.
 - 3. Comply with ANSI 117.1 and ADA requirements for graphic symbols, stall widths, and access aisles at handicapped parking spaces. Provide approved templates for symbols and directional arrows.

END OF SECTION 321723

SECTION 32 33 00 - SITE FURNISHINGS

PART I - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. ABAAS Trash Receptacle
 - 2. ABAAS Picnic Table
- B. Related Sections
 - 1. Section 32 13 13 - Concrete Paving

1.2 SUBMITTALS

- A. Comply with Division 01. All submittals shall be accepted by CO in writing prior to acquisition and installation.
- B. Samples: Provide color samples for each material and finish of each site furnishing for approval by CO.
- C. Descriptive product data: For each type of product provide a detailed cutsheet for selected product, catalog cutsheets, brochures and analyzes of manufactured items.
- D. Product Data for ABAAS compliant furnishings: Provide manufacturer's documentation of ABAAS compliant requirements.
- E. Substitutions: If specified material is not obtainable, submit proof of non-availability to CO together with options for use of equivalent material for review and acceptance by CO. No additional costs are permitted for more expensive alternate material.
- F. Immediately after work is finished, perform accessibility inspection. Comply with Section 01 40 00 Quality Requirements for documentation and reference for the CQC Accessibility Report.

1.3 QUALITY ASSURANCE

- A. Qualifications: Install work using skilled persons, proficient in the trades required, in a neat, orderly and responsible manner with recognized standards of workmanship.
- B. Regulatory requirements: Comply with regulatory agencies concerning classification, transportation, handling and storage of landscape materials.

1.4 DELIVERY, HANDLING AND STORAGE

- A. Packaged materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.
- C. Handle and store materials in manner to prevent damage or deterioration. Contractor is responsible for damage and subsequent repairs or replacement.
Stone: Exercise care in the storage on site to avoid mixing soil with stone.

- D. Rejection of material:
 - 1. Evidence of inadequate protection or improper handling or storage, shall be cause for rejection.
 - 2. Any product or material exhibiting signs of damage due to nonconformity to specifications or due to delivery, storage or handling shall be rejected by the Owner. Contractor shall be responsible for hauling off-site and disposing of according to general conditions and codes of the governing jurisdiction.

1.5.1 PROJECT/SITE CONDITIONS

- A. Environmental requirements:
 - 1. Work shall occur only when weather and soil conditions permit in accordance with locally accepted practice.
 - 2. No cobble or furnishings shall be placed on frozen or freezing ground.
- B. Existing conditions:
 - 1. Utilities: Determine location of existing and proposed underground utilities. Perform work in a manner to avoid possible damage. Hand excavate, as required.
 - 2. Excavation: Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

PART 2 – PRODUCTS

2.1 FURNISHINGS

- A. ABAAS Picnic Table
 - a. 46” x 57” Classical Pedestal Picnic Table, by National Outdoor Furniture Inc. www.nationaloutdoorfurniture.com or approved equal.
 - b. Item # WC CSQ46ADA-3PP with three attached seats.
 - c. Classic Style, Portable, ADA
 - d. Color: Brown
- B. ABAAS Trash Receptacle
 - a. CE Series Single Trash Enclosure by Bear Saver, www.bearsvaer.com or approved equal.
 - b. Item # CE140-CH, ADA complaint
 - c. Color: Brown
 - d. Label: Trash

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verification of conditions: Examine areas and conditions under which the Work of this Section will be performed. Report unsatisfactory or questionable conditions to CO.

Do not proceed with the Work until unsatisfactory conditions have been corrected.
Commencement of work implies acceptance of all areas and conditions.

1. Verify that during grading, topsoil spreading and grading operations, the ground surface was cleaned of materials that might hinder final operations.

3.2 INSTALLATION

A. Layout: Stake outline locations of cobble areas, splash pan and furnishings in accordance with Drawings. Obtain CO's approval prior to starting Work.

B. General:

1. Install items accurately as indicated and located on Drawings.
2. Obtain field verification of location for each item from Contracting Officer before proceeding.
3. Set units plumb, level and free of warp or cracking.
4. Install or reset as recommended by the manufacturer, including anchorage devices.

3.3 INSPECTION

- A. Contractor shall perform inspection of sub-contractor work immediately after work is finished. Using DSC, CQC Accessibility Inspection Report, Contractor shall record observations for conformance with ABAAS and DSC Accessibility Standards. Report can be supplemented by sketches, notation, digital images, product literature, red-line contract documents, etc. to illustrate and explain conditions. Coordinate inspections according to updated construction schedules. Submit Report to CO within 24 hours of commencing inspection.

3.2 PROTECTION

- A. Protect work and materials from damage due to operations by other contractors and trades and trespassers.
- B. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged work as directed.

END OF SECTION 32 33 00

SECTION 32 40 00 - TREE PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Protection of existing trees and vegetation to remain during the construction of the project.
- B. Related Sections:
 - 1. Section 02 41 13 - Selective Site Demolition
 - 2. Section 31 10 00 - Site Clearing

1.2 DEFINITIONS

- A. Dripline: The outermost edge of the tree's canopy or branch spread. The area within a tree's dripline is all the ground under the total branch spread.
- B. Critical Root Zone: Generally, all of the ground area included in the dripline, or to a 6' diameter from trunk, whichever is greater.
- C. Diameter (Caliper): The size (in inches) of a tree's trunk is measured at:
 - 1. -six (6) inches above grade for trunk diameters up to and including four (4) inches.
 - 2. -twelve (12) inches above grade for trunk diameters from four (4) inches up to and including eight (8) inches.
 - 3. -four and a half (4½) feet above grade for trunk diameters greater than eight (8) inches
- D. Project Consulting Arborist: An independent consultant with a degree in forestry, horticulture, or arboriculture, an American Society of Consulting Arborists (ASCA) registered consulting arborist, an International Society of Arboriculture (ISA) Certified Arborist, and / or a consultant with at least five years (5) field experience in tree preservation or on-site monitoring of public works or construction projects involving tree retention and protection.

1.3 QUALITY ASSURANCE

- A. If it appears that the completion of the construction may cause damage to the branches, roots or trunk of any tree, the Contractor shall contact Contracting Officer prior to work commencement.
- B. To prevent or minimize soil compaction, designated routes for equipment and foot traffic by work crews shall be determined prior to commencing construction activities. These routes shall be marked at the site, prior to commencement of construction, with tree protection fencing as specified.
- C. Motorized equipment and trailers, including tractors, bobcats, bulldozers, trackhoes,

trucks, cars, and carts shall not be allowed access within tree protection areas.

- D. Materials and supplies shall not be stockpiled or stored within the tree protection area.
- E. Under no circumstances shall any objects or materials be leaned against or supported by a tree's trunk, branches, or exposed roots. The attachment or installation to trees of any sign, cable, wire, nail, swing, or any other material that is not needed to help support the natural structure of the tree is prohibited.
- F. Tree Protection Plan: Contractor shall submit a tree protection plan by project consulting arborist based on the contract drawings for approval by Contracting Officer.
- G. Proposed methods and schedule for implementing tree and other plant protection shall be submitted for approval.
- H. Proposed methods, materials, and schedule for root pruning, branch pruning, and other tree maintenance shall be submitted for approval.
- I. Construction Schedule: Contractor shall submit construction schedule which includes a time frame for work near existing trees. Approval of such shall be obtained from Project Consulting Arborist prior to commencement of construction near Tree Protection Zones.
- J. Maintenance Schedule: Submit maintenance schedule to Contracting Officer.

1.4 REPLACEMENT COSTS

- A. Replacement costs for damaged vegetation will be computed (1) according to one of the methods described in the Council of Tree and Landscape Appraisers' current Guide for Plant Appraisal published by the International Society of Arboriculture, or (2) another NPS or industry –approved standard. Copies of the Guide can be obtained from the International Society of Arboriculture, P.O. Box 3129, Champaign, IL 61826-3129, (217) 355-9411 or <http://www.isa-arbor.com>.
- B. The Park will make the damage appraisal. Pruning or removal of vegetation when authorized and supervised by the Contracting Officer is exempted from these penalties.
- C. Damage of vegetation and park resources outside the designated construction limits or outside designated areas set aside for the contractor's use will incur the same fines and penalties as are applied to other parties damaging park resources.

PART 2 - PRODUCTS

2.1 TREE PROTECTION FENCING

- A. Tree protection fences should be constructed as follows:
 - 1. Galvanized Chain-link – Six feet (6') in height and free standing. Installation of fence shall not result in injury to tree surface roots, root flares or branches.
 - 2. Refer to plan for locations and approved by Contracting Officer.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide temporary barriers (e.g., chain link fence) to protect plants, trees, and critical root zones that are designated to remain but are within the construction limits. Barriers shall be in place before any construction equipment is allowed on site. Coordinate with the Contracting Officer to allow adequate time to conduct salvaging or transplanting of plant materials into or out of the project construction limits.
- B. Unless areas are specifically designated for the purpose by the Contracting Officer, the following activities are prohibited outside the construction limits and within the fenced areas surrounding trees, shrubs, and other sensitive vegetation designated to remain by the Contracting Officer and as described above:
 - 1. Parking vehicles.
 - 2. Storing materials or supplies.
 - 3. Disposing of materials including, but not limited to paint, paint thinners, fiberglass materials, fiberglass thinners, concrete or cement residue, washings from cement or concrete mixers or any other material considered harmful by the Contracting Officer.
- C. Adhere to the Park's pruning guidelines when pruning of trees or shrubs is necessary for construction activities. Avoid damage to trees or roots in or adjacent to the project during construction. All workers on the project involved in pruning operations must receive training by park staff to review methods and requirements prior to the commencement of pruning activities. Coordinate training with the Contracting Officer.
- D. Trimming or pruning of branches is to approved by the CO.
- E. Provide additional water to trees during construction activities and the growing season after construction is complete as approved by Contracting Officer. Do not provide additional fertilizer as this may further stress the trees.

3.2 TREE PROTECTION FENCING

- A. Tree protection areas shall be as approved by the Contracting Officer. Fencing locations should be staked for approval by the Contracting Officer.
- B. Fencing should be installed to completely surround the limits of tree protection areas.
- C. Tree protection fencing shall be installed prior to any site activity and shall remain until its removal is authorized by the Contracting Officer.

3.3 CONSTRUCTION OF PAVEMENTS, CURBS AND STRUCTURES

The following procedures shall be used when constructing hard surface improvements.

- A. Protect exposed roots from contamination by stabilization materials and concrete.
- B. Locate concrete washout areas away from roots and tree protection areas.
- C. After proper pruning, as needed, cover exposed roots within thirty (30) minutes to minimize desiccation. Roots may be covered with soil, mulch, or moistened burlap (7

ounce or equivalent), and shall be kept moist during the period until the final grade is established.

- D. Place a sheet of six (6) mil or thicker plastic over the grade within affected portions of tree protection areas prior to pouring concrete sidewalks, curbs, inlets, ramps, and driveway approaches. The plastic will assist in providing a non-leaching barrier between the concrete, soil and roots.
- E. Limit grading to a maximum of two (2) inches fill over natural grade within critical root zones. Fill should consist of sandy loam topsoil. Clay soils shall not be used as fill. When using fill soil, the existing surface to receive fill should be scarified prior to filling. Any filling operation should not occur during water saturated soil conditions.
- F. In areas where roots have to be removed for construction, roots shall be severed prior to excavation to eliminate unnecessary tearing of roots by equipment.
 - 1. Excavate soil by hand at the construction cut limit to a depth of thirty (30) inches or to the depth of the required root cut, whichever is less.
 - 2. Prune roots as specified.
 - 3. Protect exposed roots as specified.
- G. Concrete or chemicals spilled within tree protection areas should be completely removed. Contaminated soil shall be completely removed at the time of the spill and removed by hand without disturbance to root systems. Appropriate soil should be added as necessary to restore the grade.

3.4 DAMAGE ASSESMENT

- A. If the Contractor destroys or seriously injures plant material designated for protection or outside of the work limits, damages will be assessed prior to final progress payment, and shall be replaced at no cost to the government. Existing vegetation shall not be used to support temporary construction or permanent fencing.
- B. A damage assessment process will be triggered by any of the following types of damage to vegetation outside of clearing or construction limits or inside fenced vegetation within the construction and clearing limits:
 - 1. Removal of any designated plant material.
 - 2. Pruning or removal of more than 30% of a tree or shrub canopy.
 - 3. Removal or fracture of a limb or trunk that is one of the major structural entities of the plant.
 - 4. Removal or fracture of any limb greater than 12 inches in diameter.
 - 5. Bark damage or removal around more than 30% of the trunk circumference.
 - 6. Trenching or soil disturbance within the drip line that is deeper than 6 inches.

END OF SECTION 32 40 00

SECTION 32 91 13 - SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes preparation of soil for the purpose of planting operations. Soil preparation as specified herein must precede all landscape work.
- B. Related Requirements:
 - 1. Section 31 10 00 - Site Clearing
 - 2. Section 31 20 00 - Earth Moving
 - 3. Section 32 23 16 - Topsoil

1.2 DEFINITIONS

- A. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- B. Imported Soil: Soil that is transported to Project site for use.
- C. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- E. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- F. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- G. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- H. USCC: U.S. Composting Council.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

1.5 PREPARATION

- A. Topsoil: Install in locations and to depth shown on plans or as directed. Rip subsoil to a depth of 6" prior to placing topsoil.
- B. Areas of Previous Hardscape: Add topsoil and soil amendments as specified. TILL TO 18" DEPTH
- C. Areas of Newly Placed Topsoil:
 - 1. Protection:
 - a. Locate sewer, water, irrigation, gas, electric, phone and other pipelines or conduits and equipment prior to commencing work.
 - b. Be responsible for proper repair to landscape, utilities, walls, pavements and other site improvements damaged by operations under this section.
 - 2. Weed Control: Remove annual weeds by tilling. Remove perennial weeds by applying herbicide 1 week before soil preparation and as needed, but no sooner than 3 months before beginning work. Water prepared soil to encourage weed germination two weeks prior to applying herbicide.
 - 3. Surface Grade: Remove weeds, debris, clods and rocks larger than 1". Dispose of accumulated debris at direction of CO.
 - 4. Runoff: Take measures and furnish equipment and labor necessary to control the flow, drainage, and accumulation of water. Ensure that all excess water will run off the grades or will percolate within 12 hours.
 - 5. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion, blowing soil and accumulation of wind-deposited material on the site throughout duration of work. Refer to Earthwork specification.
 - 6. Timing: Perform soil preparation within (7) days prior to planting operations of and in accordance with final planting schedule.
- D. Areas of Existing Compacted Topsoil:
 - 1. If the existing area has turf that is sparse, stunted, anemic, weedy or was used as a construction staging and/or parking area and/or subjected to heavy visitor use, it is likely that the soils are compacted and will require ripping and/or shatter aeration to prepare the soil for revegetation. Scarify compacted soil to a 6-inc depth to loosen and bond topsoil to subsoil.

1.6 PROTECTION AND CLEANING

- A. Protection Zone: Identify tree and plant protection zones prior to start up.

- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
1. Storage of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Vehicle traffic.
 4. Foot traffic.
 5. Erection of sheds or structures.
 6. Impoundment of water.
 7. Excavation or other digging unless otherwise indicated.
- C. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off The Park's property unless otherwise indicated. Dispose of excess subsoil and unsuitable materials on-site where directed by Contracting Officer.

END OF SECTION 32 91 13

SECTION 329119 - AGGREGATE TOPSOIL COURSE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the contract, including General and Supplementary Conditions, and Division 1 specification. Sections apply, to this Section.

1.2 SUMMARY

- A. This work consists of furnishing and placing an aggregate, topsoil and seed mixture on a prepared shoulder or other surface.
- B. Related Sections:
 - 1. Division 01 Section "Temporary Erosion and Sedimentation Control" for erosion and sediment mitigation.
 - 2. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
 - 3. Division 31 Section "Earth Moving" for soil materials, site excavating, filling and grading.
 - 4. Division 31 Section "Topsoil" for soils materials and amendments.
 - 5. Division 32 Section "Asphalt Paving" for asphalt pavement removal, replacement, materials and testing.
 - 6. Division 32 Section "Concrete Pavement" for concrete pavement removal, replacement, materials and testing.

1.3 SUBMITTALS

- A. Material Certificates:
 - 1. Provide 2 copies of materials certificates signed by the material producer and the Contractor, certifying that each material item complies with, or exceeds, specified requirements.
 - 2. Provide independent testing laboratory reports on aggregates for sieve analysis, wear abrasion and other characteristics.

1.4 QUALITY ASSURANCE

- A. Standards:
 - 1. Conform materials and installation to applicable portions of Sections 300, 400, 703, Colorado Department of Transportation. "Standard Specifications for Road and Bridge Construction".

1.5 DELIVERY, STORAGE AND HANDLING

- A. Transport materials in trucks having tight, clean, non-sticking compartments. When transporting, provide covers to protect from spillage.

1.6 PROJECT/SITE CONDITIONS

- A. Grade Control:
 - 1. Establish and maintain required lines and elevations.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Aggregate for Aggregate-Topsoil Course. Conform to the following:
 - 1. Gradation AASHTO M 43, size number 57
 - 2. Quality AASHTO M 80, class E

2.2 FURNISHED TOPSOIL:

- A. As specified in Division 31, Section "Topsoil".

2.3 CONSERVED TOPSOIL:

- A. Excavated material conserved from the project improvement excavation and embankment foundation areas that is suitable for growth of grass, cover crops, or native vegetation.

2.4 SEED MIXTURE:

- A. The contractor must use the seed mixture provided by the NPS.
- B. The NPS reserves the right to change the seed mix depending on available seed stock. The NPS will provide a final seed mix to the contractor prior to the start of work.

2.5 WATER: Conform to the following:

- A. Water for planting or care of vegetation. Furnish water that is free of substances injurious to plant life such as oils, acids, alkalis, or salts.
- B. Water for earthwork, pavement courses, dust control, and incidental construction. Furnish water free of substances detrimental to the work.

PART 3 - EXECUTION

3.1 AGGREGATE TOPSOIL COURSE:

- A. PREPARING SURFACE: Complete the adjoining pavement before placing an aggregate-topsoil mixture on the shoulder. Scarify the area where the mixture is to be placed to a depth of 6 inches. Reduce all clods and sod to a maximum size of 4 inches.
- B. MIXING, PLACING AND COMPACTING: Furnish a mixture of 50 ±10 percent aggregate and 50 ±10 percent topsoil by volume with sufficient water for compaction.
 - 1. Mix the component into a uniform mixture. Spread the mixture on the prepared surface in a uniform layer. Shape the mixture to the line, grade, and cross-section. Remove all clods and stones greater than 1 inch in diameter. Before compaction, dry seed the mixture surface at a rate of 75 pounds per acre.
 - 2. Uniformly compact the mixture so that it does not exhibit heaving, pumping, rutting or shearing. After compaction, dry seed the surface again at a rate of 75 pounds per acre.

3.2 ACCEPTANCE:

- A. See Table 31 91 19.14-1 for sampling and testing requirements.
- B. Final review and inspection shall be made by the Contracting Officer before the work is accepted.
- C. Native seed installations shall be minimally established to meet the following criteria by Substantial Completion as determined by Contracting Officer:
 - 1. Within three months, total vegetation cover in all zones seeded with cover crop shall exceed 75% (by aerial cover). Seeded area shall be free of weeds, foreign grasses, disease and harmful insects.
 - 2. By the end of the first full growing season after seeding, total vegetation cover including cover crop shall exceed 90% (by aerial cover) and 10% of all species present shall be native.
 - 3. By the end of the first full growing season, seedling from 20% of planted forb species shall be present.
 - 4. At any time during the contract period the seeded area shall not be dominated by aggressive exotic species such as, but not limited to, red clover (*Trifolium* spp.), white or yellow sweet clover (*Melilotus* spp.), Canada thistle (*Cirsium arvense*), tall fescue (*Festuca elatior*), bindweed (*Convolvulus arvensis*) etc.
 - 5. Until final acceptance seeded areas that fail after having been replaced previously, shall be replaced until it meets establishment as required above. Replacement materials shall be identical to those originally specified. Provide seed tags to the Contracting Officer for verification.
 - 6. Remedial action: If seeded areas greater than 10 square feet fail to meet the terms of the guarantee shown above, the Landscape Contractor will develop and submit to the Contracting Officer a remedial action plan that takes into consideration the site goals and specific deficiencies causing the remedial action. Contractor will implement the remedial action plan and submit a report that describes the remedial action taken. If remedial seeding

- or planting is required, Contractor will not be required to perform additional remedial seeding or planting in the same area for a minimum of two growing seasons.
7. Seeded areas will not be accepted in parts. Each time any portion or section of the entire seeded area requires replacement or remedial action, the maintenance period shall extend until all seeded areas meet the minimum establishment requirements stated above.
 8. All expense incurred for the replacement and or establishment of the seed areas are the responsibility of the Contractor.
 9. If seeded in the fall, review for establishment shall be no later than June 15 of the following year.

Table 31 91 19.14-1								
Sampling and Testing Requirements								
Material or Product	Type of Acceptance (Subsection)	Characteristic	Category	Test Methods Specifications	Sampling Frequency	Point of Sampling	Split Sample	Reporting Time
Aggregate Topsoil	Measured and tested for conformance (01 77 00)	Moisture Density	-	AASHTO T 99, method C (minimum 5 points per proctor)	1 per soil blend	Production output or stockpile	-	36 hours
		Compaction	-	AASHTO T 310 or other approved procedures	1 per 4000 sq/yd	In-place	-	24 hours

END OF SECTION 329119.14

SECTION 32 92 19 – SEEDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 1. Temporary Stabilization.
 2. Preparation for Seeding.
 3. Hydroseeding.
 4. Seeding.
 5. Maintenance.

1.2 RELATED WORK

- A. Section 31 10 00 - Site Clearing
- B. Section 31 20 00 - Earth Moving

1.3 DEFINITIONS

- A. Weeds: Vegetative species other than specified species to be established in given area.

1.4 SUBMITTALS

- A. Product Data: Submit data for mulch, tackifier, and other accessories.

1.5 EQUIPMENT CLEANING

- A. Hydro-Mulch/Seeding Equipment Cleaning: All hydro-seeding/mulching equipment used in the park will be free of all mud, seed, and mulch materials when they enter the park. At a minimum all equipment including tanks, trailers, and all associated hydro-mulching parts will be triple rinsed with clean water. The contractor is responsible for inspecting and removing any seed or fibers from the interior of the hydro seeding equipment. This will require the contractor to use proper OSHA safety procedures to physically inspect the enclosed interior space of the hydro-seeding equipment tank and all of its parts. This type of inspection is necessary to assure no foreign seed is brought into the Park.
 1. All equipment and parts will be inspected by park personnel to assure no residual seed, mulch, or foreign material is present.
 - a. Contractor shall provide a minimum of 3 days' notice to park before moving equipment into the park.
 2. If equipment does not meet the above cleanliness standards, the equipment will not be allowed on site and must be reinspected after all equipment has been cleaned to meet the standard of cleanliness.

1.6 QUALITY ASSURANCE

- A. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section with minimum 3 years documented experience.
- B. Installer must provide a list of relevant project experience and 3 references available for contact.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.

PART 2 - PRODUCTS

2.1 SEED MIXTURE

- A. The contractor must use the seed mixture provided by the NPS. The contractor should anticipate the application rate of seed to be between 80 and 200 pure live seeds per square foot.
- B. The NPS reserves the right to change the seed mix depending on available seed stock. The NPS will provide a final seed mix to the contractor prior to the start of work.

2.2 AMENDMENTS: No fertilizers, mycorrhizae, or other amendments shall be added to the project areas.

2.3 MULCH MIXTURE

- A. Mulching Material: 100% Aspen wood fibers
 1. Moisture: 10.0% ± 3% PH 5.4 ± 0.1
 2. Organic matter (oven dried basis): 99.3% ± 0.2
 3. Inorganic Ash (oven dried basis): 0.7% ± 0.2
 4. Water Holding: 1,402%
 5. A minimum of 50% of the fibers will be equal to or greater than 0.15 inch.
 6. 75% or more will be retained on a 28 mesh screen.
 7. American Excelsior (1-800-777-Soil) or approved equal.
 8. Mulching Material must conform to the following:
 - a. Colored with a green dye non-injurious to plant growth;
 - b. Readily dispersible in water;
 - c. Nontoxic to seed or other plant material;
 - d. Free of growth or germination inhibiting substances;
 - e. Free of weed seed;
 - f. Air dried to an moisture content of 12±3 percent;
 - g. Packaged in new labeled containers with the manufacturer's name; and

- h. Packaged in a condition appropriate for mixing in a homogeneous slurry suitable for application with power spray equipment.

2.4 EMULSION TACKIFIERS

- A. Non asphalt emulsions having a water soluble, natural guar gum base (or equivalent), blended with dispersal and hardening agents. All ingredients are non-toxic, 100% environmentally safe and natural and biodegradable. The emulsion can be used with a variety of mulch types or fibers. The emulsion shall have good cover and adherence to soil. The cured product has high resistance to wind and rain drop impacts.
- B. Apply at the manufactures recommended rate consistent with the conditions at the desired location. Mulch and tackifier must be applied per manufacturer's requirements for steep slope stabilization with a functional longevity greater than or equal to, 12 months.

2.5 ACCESSORIES

- A. Water: Clean, fresh, and free of substances or matter capable of inhibiting vigorous growth of grass.
 - 1. The contractor may use the NPS quick-fill water station located in the East Headquarters Utility Area at no charge. It is approximately a half mile from the work area.
- B. Hydro-Mulching/Seeding Attachments: All hydro-mulching/seeding hoses shall be newly purchased for this project. Contractor shall submit receipts to CO prior to use in Park. Only new hoses shall be used on park projects.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify prepared soil base is ready to receive the Work of this section. Final grading shall be in accordance with Specification Section 31200.

3.2 TEMPORARY STABILIZATION

- A. If construction is completed between May 15th and October 1st, the contractor shall provide temporary non-vegetative stabilization within 14 days of temporary or permanent cessation of work in any portion of the site.
 - 1. Stabilization shall be the application of hydromulch with no seed.
- B. Hydromulch
 - 1. Apply mulch only at the rate of 1500 lbs. per acre/1681.27 kg per hectare.
 - 2. Mulch will be accepted when it uniformly covers the area being applied and is no less than ¼" thick at the time of application. Mulch applied to non-designated areas, such as roadways is to be cleaned immediately following application and will not be counted towards the total being applied.

3.3 TIME OF SEEDING October 1 to November 15.

3.4 PREPERATION FOR SEEDING

- A. Prior to hydroseed placement, scarify or disk hydromulch and topsoil to depth of 4 inches where hydroseed is to be placed. Repeat cultivation in areas where equipment has compacted sub-soil.

3.5 HAND SEEDING AND HYDROSEEDING – METHOD #1

- A. Two Step Hydroseeding Method
 1. First Application (Seed): Hand Application: In the field measure and mark areas to be seeded in $\frac{1}{4}$ or $\frac{1}{2}$ acre intervals. Mix seed with sand, or other weed free inert matter, at a 1:1 ratio to aid in seed dispersal. Divide government furnished seed into quantities appropriate for marked areas and evenly apply seed to the entire area. Do not seed if winds exceed 10 mph. Lightly rake the seed into the soil to a depth of $\frac{1}{8}$ to $\frac{1}{4}$ ".
 2. Second Application (Seed): Apply mulch in a separate application from the seed using hydraulic-type equipment. Apply wood fiber or grass straw cellulose fiber mulch at a rate of 1900 pounds per acre. Mulch by hand areas inaccessible to mulching equipment. Apply tackifier at a rate of 80 lbs. per acre on slopes less than 3H:1V and apply at a rate of 100 lbs./acre on slopes greater than 3H:1V.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Do not sow immediately following rain, when ground is too dry, when winds are over 12 mph, or when rain is forecasted shortly after application..
- D. Immediately following seeding, apply mulch to thickness of $\frac{1}{8}$ inches. Maintain clear of shrubs and trees.
- E. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.
- F. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil.
- G. Do not seed areas in excess of that which can be mulched on same day.
- H. Do not spray immediately following rain, when ground is too dry, when winds are over 12 mph, or when rain is forecasted shortly after application.
- I. The Contractor shall spray designated areas with the slurry in a sweeping motion and in an arched stream until a uniform coat is achieved, with no slumping or shadowing, as the material is spread at the required rate.
- J. The hydroseed slurry should float down from the arched stream, as opposed to being shot directly at the ground.
- K. During hydroseeding the existing native vegetation must be protected from damage (including, but not limited to, coating with mulch, damage by direct spray, and dragging hose).

3.6 HYDROSEEDING - METHOD #2

A. Two Step Hydroseeding Method

1. First Application (Seed and Mulch Tracer): Use hydro-type equipment (must use centrifugal pump) capable of providing a uniform application using water as the carrying agent. Add 400 lbs. per acre of hydro-mulch consisting of wood cellulose fiber mulch as a tracer material to the water. The Contractor will ensure equipment is properly agitated for even distribution. Add the seed to the water slurry no more than 30 minutes before application.
 - a. Apply mulch and seeded slurry with hydraulic seeder at rate of 400 lbs. per acre on slopes less than 3H:1V. Apply at a rate of 400 lbs per acre on slopes greater than 3H:1V. Apply evenly and within project limits. Include seed in slurry so it will be spread at a rate of 200 seeds per square foot on all slopes.
 - b. Seed by hand areas inaccessible to seeding equipment, see standard below.
 - c. Do not use seed that has become wet, moldy, or otherwise contaminated or damaged.
2. Second Application (Mulch): Using the same equipment, make a second pass, applying mulch only at the rate of 1500 lbs. per acre. On slopes greater than 3H:1V the second pass pf mulch should be made at a rate of 2000 lbs. per acre.
 - a. Mulch will be accepted when it uniformly covers the area being applied and is no less than ¼” thick at the time of application. Mulch applied to non-designated areas, such as roadways is to be cleaned immediately following application and will not be counted towards the total being applied.

- B. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil.
- C. Do not seed areas in excess of that which can be mulched on same day.
- D. Do not spray immediately following rain, when ground is too dry, when winds are over 12 mph, or when rain is forecasted shortly after application.
- E. The Contractor shall spray designated areas with the slurry in a sweeping motion and in an arched stream until a uniform coat is achieved, with no slumping or shadowing, as the material is spread at the required rate.
- F. The hydroseed slurry should float down from the arched stream, as opposed to being shot directly at the ground.
- G. During hydroseeding the existing native vegetation must be protected from damage (including, but not limited to, coating with mulch, damage by direct spray, and dragging hose).

3.7 HAND SEEDING AND HYDROSEEDING – METHOD #2

- A. Apply seed at rate of 80 seeds per square foot evenly in two intersecting directions. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Planting Season: Seeding will occur either before May 15 or after October 1 in any given year.

- D. Do not sow immediately following rain, when ground is too dry, when winds are over 12 mph, or when rain is forecasted shortly after application..
- E. Immediately following seeding, apply mulch to thickness of 1/8 inches. Maintain clear of shrubs and trees.
- F. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.
- G. After seeding activities are complete, temporary carsonite posts shall be placed at project locations with a potential for unwanted vehicle/foot traffic.

3.8 MAINTENANCE

- A. Repair washouts or gullies which occur within the first 3 months after seeding.

END OF SECTION 32 92 19

SECTION 32 93 10 – LANDSCAPE BOULDERS

PART 1—GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Examination of conditions, preparation, and installation of boulders at Kiosk medians and along Fall River Road north of sidewalk.

1.2 RELATED WORK

- A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions, and Division 1 - Specification Sections, apply to the provisions of this section.
- B. Related Sections:
 - 1. Section 02 41 13 - Selective Site Demolition

1.3 QUALITY ASSURANCE

- A. Regulatory requirements: Comply with regulatory agencies concerning classification, transportation, handling, and storage of landscape materials.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Storage: store and protect all existing landscape boulders to be reset in areas approved by Contracting Officer.
- B. Rejection of material:
 - 1. Evidence of inadequate protection or improper handling or storage, shall be cause for rejection.
 - 2. Any product or material exhibiting signs of damage due to nonconformity to specifications or due to moving, storage or handling shall be rejected by the Government. Contractor shall be responsible for hauling off-site and disposing of according to general conditions and codes of the governing jurisdiction.

1.5 PROJECT/SITE CONDITIONS

- A. Environmental requirements:
 - 1. Work shall occur only when weather and soil conditions permit in accordance with locally accepted practice.
 - 2. No bedding, stone, riprap, grout, or boulders shall be placed on frozen or freezing ground.
- B. Existing conditions:
 - 1. Utilities: Determine location of existing and proposed underground utilities. Perform work in a manner to avoid possible damage. Hand excavate, as required.
 - 2. Excavation: Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

PART 2—PRODUCTS

2.1 LANDSCAPE BOULDERS

- A. Boulders will be granite boulders collected from site, salvaged, stored, and reset in the locations indicated on the Drawings and approved by Contracting Officer

PART 3—EXECUTION

3.1 EXAMINATION

- A. Verification of conditions: Examine areas and conditions under which the Work of this Section will be performed. Report unsatisfactory or questionable conditions to the Contracting Officer. Do not proceed with the Work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.
 - 1. Verify that during grading, topsoil spreading and landscape grading operations, the ground surface was cleaned of materials that might hinder final operations.

3.2 PREPARATION

- A. Protection: Protect areas in accordance with this Section.
- B. Layout: Stake locations of landscape boulders in accordance with Drawings. Boulders are to be placed by the Contracting Officer and landscape architect. Provide 72-hour notice to Contracting Officer and landscape architect ahead of placement day and starting Work.

3.3 BASE COURSE

- A. General: Gravel installation and compaction of these materials as required forming a firm, uniform, accurate and unyielding surface at required elevations and to required lines, shall be done under this Section.
- B. Aggregate Base Course: see Section 31 20 00 Earth Moving

3.4 BOULDER PLACEMENT

- A. Specific boulders will be identified by the Contracting Officer for placement in specific locations of the project.
- B. Excavate subgrade and install base course material in depth indicated on the Drawings, compacted to 95%. Install in lifts no greater than 4 inches. Set top of base course so that at least 1/3 of the boulder is buried when set at the specified elevation.
- C. Carefully place boulders over compacted base course. Bury boulder as indicated on the drawings. Ensure that the boulder is securely in place.

- D. Orientate the boulder so that the best side and face is exposed. Readjust placement of boulder at the direction of the Contracting Officer.
- E. Place boulders at locations and depths indicated on the Drawings. Expose weathered faces. Lay boulders horizontal with finish grade, not on edge.
- F. Backfill with excavated material thoroughly compact and blend grade smooth with surrounding grade.

3.5 CLEANUP

- A. During installation: All areas shall be clean at the end of each workday. Sidewalks and other paved areas shall be swept or washed down as needed. Keep pavements clean and work area in an orderly condition.
- B. Project completion: All debris, soil, trash, and excavated and/or stripped material resulting from operations and unsuitable for or in excess of requirements for completing work of this Section shall be disposed of off-site. All paved areas shall be washed down.

3.6 PROTECTION

- A. Protect work and materials from damage due to operations by other contractors and trades and trespassers.
- B. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged work as directed.

END OF SECTION 32 93 10

SECTION 32 96 43 - TREE TRANSPLANTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for furnishing all labor, equipment, and materials required to transplant trees (Ponderosa Pines) from the site to new locations on the site, and restore tree excavation area as directed by the Contracting Officer.
- B. Related Work:
 - 1. Section 31 10 00 - Site Clearing
 - 2. Section 31 20 00 - Earth Moving
- C. General: See definitions in ANSI A300 (Part 6) and in ANSI Z60.1 pertaining to field-grown trees, except as otherwise defined in this Section.
- D. Caliper: Caliper of a trunk as measured by a diameter tape at a height six-inches (6") above the root flare for trees up to, and including, four-inch (4") size at this height; and as measured at a height of twelve-inches (12") above the root flare for trees larger than four-inch (4") size.
- E. Diameter Breast Height (DBH): Diameter of a trunk as measured by a diameter tape at a height 54-inches (54") above the ground line for trees with caliper of six-inches (6") or greater as measured at a height of twelve-inches (12") above the root flare. Per ANSI Z60 American Standard for Nursery Stock.
- F. Root-Ball Depth: Measured from bottom of trunk flare to the bottom of root ball.
- G. Root-Ball Width: Measured horizontally across the root ball with an approximately circular form or the least dimension for non-round root balls, centered around the trunk within a 10% Root tolerance according to ANSI Z60.1.
- H. Root Flare: Also called "trunk flare". The area at the base of the tree's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each of the following:
 - 1. Proprietary Root-Ball-Stabilization Device: One unit.
 - 2. Slow-Release Watering Device: One unit of each size required.
- C. Existing Conditions: Documentation of existing trees indicated to be transplanted, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
 - 1. Use sufficiently detailed color photographs or video recordings. Color shall accurately depict hue condition of foliage and bark.

2. Include drawings and notations to indicate specific wounds and damage conditions of each tree designated to be transplanted.

1.5 QUALITY CONTROL

- D. Tree-Service Firm Qualifications: An experienced landscaping contractor or tree-moving firm that has successfully completed transplanting work similar to that required for this Project.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Collect transplants when soil is moist. If precipitation has not occurred, irrigate prior to lifting. Removal and transplantation should only occur in the mornings on cool, cloudy days when the plant is fully turgid.
- B. Mark the orientation of the plant on the stem. Using the "dripline" of the plant as a guide, make shovel cuts with the blade as perpendicular to the surface of the ground as possible because maintaining an intact ball of soil around the roots is important. Root morphology shall be considered in this process. Roots growing in deep soils or arid soils will tend to grow down rather than laterally. Roots growing in shallow soils will tend to spread laterally, requiring a much larger area of disturbance. Do not attempt to transplant plants if the soil falls off the root system.
- C. Lift the root ball gently out of the hole while attempting to keep the root ball intact. Hand pruners/saws can be used to cut away woody roots that do not come free during removal. Cover the root ball with damp untreated burlap until planting. The root ball can then be transferred to a suitable container (large bucket, pot, burlap, or plastic bag) for transport to the transplanting site/nursery. The plant must be protected when transporting to a planting site or nursery. Covered trucks and vans are best, but if a pickup truck is used, a tarp must be in place to protect the plant canopies and roots from drying winds in transit.
- D. Move trees after preparations for planting have been completed, and install immediately.
- E. Temporary Storage: If transplants cannot be planted in one day, they can be stored in the field in a well-sheltered area protected from the sun and animals. If plants are left out, the root plug should not be allowed to dry out. If they do lose moisture, the containers should be irrigated prior to planting.

1.7 SITE CONDITIONS

- A. Transplanting operations shall be conducted under favorable weather conditions, on a cool, cloudy day and during the tree's dormant period (November 1 to March 31), unless otherwise approved by Contracting Officer.
- B. At least seventy-two (72) hours prior to beginning transplanting work, the Contractor shall contact UNCC at 811 for location of respective underground utilities. No transplanting shall occur until all utilities have been located.

1.9 WARRANTY

- A. Installer's Special Warranty: Tree-service firm agrees to repair or replace trees and related materials that fail within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth except for defects resulting from vandalism, lack of adequate maintenance, neglect by park staff, or incidents that are beyond Contractor's control.
 - 1) Death and unsatisfactory growth is defined as more than twenty-five percent (25%) dead, dead or declining central leader, or in an unhealthy condition or failure to meet general performance requirements at end of warranty period.
 - b. Structural failures including tree(s) falling or blowing over, split branches or snapped tops.
 - c. Faulty performance of materials and devices related to tree plantings including tree stabilization and watering equipment.
2. Warranty Periods from Date of Substantial Completion:
 - a. Trees: One (1) year.
3. Include the following remedial actions as a minimum
 - a. Remove dead trees and trees with unsatisfactory growth at end of warranty period; replace when directed.
 - b. Replace materials and devices related to tree plantings.
 - c. Provide extended warranty for period equal to original warranty period, for replaced trees.

PART 2 - PRODUCTS

2.1 TREES TO BE TRANSPLANTED

- A. Trees to be transplanted shall be (12) Ponderosa Pines and directed by Contracting Officer.

2.2 WATER

- A. Water shall be potable and supplied by Contractor at planting.
- B. Water shall contain no substances harmful to plant life.
- C. Water planted ponderosa pines for at least one growing season. Water weekly, unless there is rainfall of 1/2-inch or greater that week from June 15 - Sept 15.

2.3 PLANTING MATERIALS

- A. Backfill Soil: Excavated soil mixed with planting soil conditioner of suitable moisture content and granular texture for placing and compacting in planting pit around tree, and free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.
 1. Mixture: Well-blended mix of two parts excavated soil to one-part soil conditioner.

2.4 TREE-STABILIZATION MATERIALS

- A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new softwood with specified wood preservative treatment by pressure process, free of knots, holes, cross grain, and other defects, 2-inch (2") diameter by length indicated, pointed at one end.
2. Wood Deadmen: Timbers measuring eight inches (8") in diameter and forty-eight inches (48") long, treated with specified wood preservative treatment by pressure process.
3. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, #14 galvanized-steel wire, two-strand, twisted.
4. Guy Springs: Submit manufacturer's product information for approval.
5. Tree-Tie Webbing: UV-resistant nylon webbing with brass grommets, size as indicated.
6. Flags: One-half-inch (1/2") diameter PVC pipe, length as indicated.

2.5 MISCELLANEOUS PRODUCTS

- A. Organic mulch, free from disease pathogens, weeds, chemicals, and other deleterious materials and suitable as a top dressing of trees and shrubs, consisting of chipped bark and/or wood material not larger than four-inches (4") in length and half inch (1/2") in width. Submit 1.0 cubic foot sample for approval. Mulch is to be weed-free.
- B. Slow-release, non-synthetic tree fertilizer nugget.
- C. Burlap: Non-synthetic, biodegradable.

PART 3 - EXECUTION

3.1 GENERAL

- A. Proposed locations for trees to be transplanted shall be staked and approved by Contracting Officer prior to beginning planting operations. New locations shall be on site as shown on Contract Drawings, or as directed by CO.

3.2 EXAMINATION

- A. Examine areas where the Work of this Section will be performed for compliance with requirements and conditions affecting installation and performance.
 1. Verify that no foreign or deleterious material or liquid such as, but not limited to, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within the work area.
 2. Verify that final grades are completed in accordance with the drawings.
- B. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross transplanting areas.
- C. Proceed with transplanting only after unsatisfactory conditions have been corrected and approval to proceed given by Contracting Officer

3.3 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, other facilities, turf areas, and other plants and planting areas from damage caused by transplanting operations. Repair damage to site elements noted above that result from construction activities at no additional cost to government.
- B. Utility Locator Service: Notify utility locator service before beginning excavation. All utilities are to be marked and a hard-copy diagram of utility locations from the utilities locator service given to Contracting Officer prior to excavation.
- C. Locate and clearly identify trees for transplanting.
- D. Lay out individual transplant locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Contracting Officer's acceptance of layout before transplanting. Make minor adjustments as required.
- E. Dig pits immediately prior to moving plants to their respective locations for planting to ensure that they will not be unnecessarily exposed to drying elements or to physical damage.
 - 1. Circular pits with vertical sides hard-trimmed shall be excavated with tree spade to a depth such that tree, when planted, will sit two-inches (2") to three-inches (3") above surrounding grade.
 - 2. Sides of pit shall be scarified or roughened by hand to eliminate glazing.
 - 3. The planting pit shall be prepared per ANSI A300 part 64.4.4.
- F. It is not anticipated that planting shall be done where the depth of soil over rock or other underground obstructions is insufficient to accommodate the roots or where pockets in rock or impervious soil will require drainage. If such conditions are encountered in the excavation of planting areas, and if the stone, boulders or other underground obstructions cannot be broken and removed by hand methods in the course of digging plant pits of the usual size, other locations for the planting may be designated by Contracting Officer. Removal of rock or other underground obstructions and relocation of plant materials shall be done only as directed by the Contracting Officer.
- G. Seepage: Notify Contracting Officer if subsoil conditions evidence unexpected water seepage into tree-planting pits.
- H. Drainage: Fill planting pit half full of water and time the infiltration rate of the soil. If the drainage rate is less than 1-inch per hour, notify Contracting Officer.
- I. The Contractor shall dispose of excess excavated planting pit material by filling and compacting the holes created by moving the trees.

3.4 SIZE OF TREE SPADE

- A. The size of the mechanical tree spade to be used for transplanting shall be 10-inches (10") (minimum) in size for every 1-inch of tree caliper. Minimum size spade shall be 48-inches (48").

3.5 TRANSPLANTING TREES

- A. General: Coordinate the transplanting of trees with the Contracting Officer.
- B. Orientation Marking: Mark the north side of each tree with non-permanent paint before extracting.
- C. Root-Ball Width: Minimum ten-inches (10”) of root-ball diameter, or least dimension for non-round root balls, for each-inch of tree caliper being transplanted.
 - 1. Out-of-Season Planting: If planting before or after the in-season period for tree, provide a minimum root-ball diameter of twelve-inches (12”) for each-inch of tree caliper being transplanted.
- D. Root-Ball Depth: As determined by the arborist for each species and size of tree and for site conditions at original and planting locations.
- E. Extracting with Tree Spade: Obtain Contracting Officer’s approval to use tree spade for tree transplanting.
 - 1. Use the same tree spade to extract the tree as will be used to transport and plant the tree
 - 2. Do not use tree spade to move trees larger than the manufacturer's maximum size recommendation for the tree spade being used.
 - 3. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.

3.6 SETTING TREES

- A. Planting Standard: Perform planting according to ANSI A300 (Part 6) unless otherwise indicated.
- B. Relocate trees to be transplanted within one working day to locations approved by the Contracting Officer.
- C. Before planting, verify that root flare is visible at top of root ball. If root flare is not visible, carefully remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements and planting hole depth is appropriate.
- D. Ensure that root flare is visible after planting.
- E. Orientation: Position the tree so that its north side, marked before extracting, is facing north in its new location.
- F. Trees shall be planted in pits to such a depth that the root flare at the plant after settlement will be two-inches (2”) above that at which the plant is currently growing. Trees shall be planted upright with trunks plumb and faced areas as described in the “Orientation” article above.
- G. Till a two foot (2’) radius to a depth of 6” around tree after transplanting to have loosened soil for new roots to establish.

- H. A saucer shall be formed extending twenty-four inches (24") beyond edge of individual planting pit to cover tilled area.
- I. Slopes: When planting on slopes, set the tree so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.
- J. Trees shall be thoroughly watered immediately after planting. After excavation and before planting, the planting holes shall be filled with water. After the water has drained, add a slow-release, non-synthetic tree fertilizer nugget/cake in each hole (at rates consistent with vendor label - release at minimum 3 months, up to 12 months).

3.7 TREE STABILIZATION

- A. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Contract Drawings or directed by Contracting Officer.
 - 1. Site-Fabricated Staking Method: Stake transplanted trees sized up to four-inch (4") caliper. Install number of stakes as indicated.
 - a. Retain options for compression springs in subparagraphs below to provide more line flexibility than turnbuckles.
 - b. Drive stakes into undisturbed grade outside tree pit soil transition zone as indicated. Avoid penetrating root balls or root masses.
 - c. Securely attach specified wire to stakes.
 - d. Support trees with specified wire and tree tie webbing from the tree trunk to each stake. Allow one to two inches (1" to 2") of slack to avoid rigid restraint of the tree.
 - e. Attach thirty-six (36") long by one-half-inch (1/2") diameter PVC pipe flagging to each wire.
 - 2. Site-Fabricated Guying Method: Guy transplanted trees greater than four-inch (4") caliper. Install no fewer than three (3) guys spaced equally around tree.
 - a. For trees over four-inches (4") to six-inches (6") caliper, securely attach guys to specified anchor thirty-inches (30") long, driven in to undisturbed soil outside tree pit as indicated. Avoid penetrating root balls or root masses.
 - b. Install one (1) compression spring approved by Contracting Officer in each guy assembly.
 - c. For trees larger than six-inches (6") in caliper, anchor guys to wood deadmen buried at least thirty-six (36")-inches below grade.
 - d. Support trees with specified wire and tree tie webbing at contact points with tree trunk and reaching to specified anchor. Allow enough slack to avoid rigid restraint of tree.
 - e. Attach thirty-six (36") long x one-half-inch (1/2") diameter PVC pipe flagging to each wire.

3.8 MULCHING

- A. Organic Mulch: Apply three-inch (3") average thickness of organic mulch extending twenty-four inches (24") beyond edge of individual planting pit to cover tilled area, and finish level with adjacent finish grades. Do not place mulch within three-inches (3") of trunks or stems.

3.9 MAINTENANCE OF TRANSPLANTED TREES

- A. Tree plantings shall be protected and maintained by the Contractor until Final Acceptance.
- B. Maintenance shall include watering, weeding, cultivating, mulching, removal of dead branches, resetting plants to proper grade or upright position and restoration of tree planting saucers and other necessary operations.

3.10 CLEANUP AND PROTECTION

- A. During transplanting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect trees from damage due to transplanting operations and operations of other contractors and trades. Maintain protection during transplanting and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After planting and before Substantial Completion, remove tags, markings, tie tape, labels, wire, burlap, and other debris from transplanted trees, planting areas, and Project site.

3.11 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Except for materials indicated to be recycled, remove surplus soil, excess excavated material, waste materials, displaced plants, trash, and debris, and legally dispose of them off site.
- B. Transport surplus satisfactory soil to designated storage areas on site. property. Stockpile or spread soil as directed by Contracting Officer.

END OF SECTION 32 96 43

SECTION 330130 - CURED-PLACE PIPE (CIPP)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section covers the rehabilitation of sanitary sewer mains using cured-in-place pipe (CIPP). CIPP involves the installation of a resin-impregnated, flexible fabric tube into an existing sanitary sewer main followed by inflation of the tube and curing of the resin to form a structurally sound liner.
- B. The Contractor shall furnish all labor, equipment, materials, plans and supervision required to complete the operations necessary to perform the described work.

1.2 RELATED DOCUMENTS

- A. Division 33 Section "Sanitary Utility Sewerage Piping"

1.3 QUALITY ASSURANCE

- A. American Society for Testing and Materials (ASTM) standard specifications, which are made a part hereof by such reference and shall be the latest edition and revision thereof.
 - 1. D-543 Testing Method of Resistance of Plastics to Chemical Reagents
 - 2. D-578 Specifications for Glass Fiber Strands
 - 3. D-638 Testing Method for Tensile Properties of Plastics
 - 4. D-790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - 5. D-792 Standard Test Methods for Density and Specific Gravity of Plastics by Displacement
 - 6. D-1600 Terminology for Abbreviated Terms Relating to Plastics
 - 7. D-1682 Test Method for Breaking Load and Elongation of Textile Fabrics
 - 8. D-2122 Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
 - 9. D-2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
 - 10. D-3039 Test Method for Tensile Properties of Polymer Matrix Composite Materials
 - 11. D-3567 Practice for Determining Dimensions of Reinforced Thermosetting Resin Pipe (RTRP) and Fittings
 - 12. D-3681 Standard Test Method for Chemical Resistance of Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe in a Deflected Condition
 - 13. D-5813 Specification for Cured-in-Place Thermosetting Resin Sewer Pipe
 - 14. F-412 Terminology Relating to Plastic Piping Systems
 - 15. F-1216 Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

16. F-1417 Test Method for Installation Acceptance of Gravity Plastic Sewer Lines Using Low pressure Air Testing
 17. F-1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pull in and Inflate and Curing of a Resin-Impregnated Tube
 18. F-2019 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)
- B. NASSCO Standard: Performance Specification Guideline for the Installation of Cured-in-Place Pipe (CIPP).

1.4 SUBMITTALS

- A. Contractor shall submit shop drawings, product data, and/or manufacturer's literature showing CIPP construction materials (including fabric tube and resin), installation and curing method, installed characteristics, and certifications that product conforms with these specifications. Contractor shall indicate where submittals do not conform to these specifications.
- B. Contractor is responsible for obtaining all applicable City, County, and State permits for the project. Submit copies of all permits issued for project.
- C. Compatibility and Adhesion Test Reports

1.5 SAFETY

- A. Contractor shall conform to all worker safety requirements, including but not limited to OSHA standards and MUTCD traffic control.
- B. Contractor shall utilize trained personnel to perform the work.

1.6 WARRANTY

- A. Contractor shall warrant the installed CIPP to be free from defects for one (1) year from the date of acceptance by the Government. This warranty shall include all components of the CIPP.

PART 2 - MATERIALS

2.1 CURED-IN-PLACE PIPE (CIPP)

- A. General: The fabric tube and resin shall produce a CIPP that meets the requirements of these specifications. The design service life shall be a minimum of 50 years.
- B. Fabric Tube: The fabric tube shall consist of one or more layers of absorbent non-woven fabric, felt/fiberglass, or fiberglass and meet the requirements of ASTM D-5813, ASTM F-1216, ASTM F-1743, and ASTM F-2019. The tube shall be properly sized to fit the internal circumference of the existing pipe, and be able to stretch to fit irregular pipe sections and bridge missing pipe segments.

- C. Resin: The resin shall consist of a corrosion resistant polyester or vinyl ester resin and catalyst system or an epoxy resin and hardener system that is compatible to the installation process and meets the requirements of ASTM F-1216, ASTM F-1743, or ASTM F-2019. The cured resin shall produce CIPP which will comply with the structural and chemical resistance requirements of this specification.
- D. Structural Requirements:

Property	Test Method	Minimum Value
Flexural Modulus of Elasticity	ASTM D-790	250,000 psi
Flexural Strength	ASTM D-790	4,500 psi
Tensile Strength	ASTM D-638 ASTM D-3039	2,500 psi

2.2 TOP HAT TYPE SERVICE LATERAL SEALING SYSTEM (SLSS)

- A. The finished SLSS product shall be fabricated from materials which when cured will be chemically resistant to withstand internal exposure to domestic sewage.
- B. All constituent materials will be suitable for service in the environment intended. The final product will not deteriorate, corrode or lose structural strength that will reduce the projected product life.
- C. The SLSS product shall also be compatible with the lining system utilized in the main sanitary sewer line.
- D. A flexible fiberglass tube shall be fabricated to a size that when installed will nearly fit the internal circumference sanitary service. Allowance shall be made for circumferential stretching during insertion.
- E. The minimum length shall be that deemed necessary by the installer to effectively scan the distance from the lateral connection at the main to the desired termination location in the service lateral pipe. The minimum length of the SLSS connection shall not be less than 4-inches and the maximum length of the SLSS shall not exceed 8-inches.
- F. Unless otherwise specified, the installer shall furnish a specially designed, unsaturated polyester or vinyl ester resin, and catalyst system compatible with the SLSS ultra violet light cure process that provides cured physical strengths specified herein.
- G. The cured SLSS shall conform to the minimum structural standards as listed below:

Final SLSS	ASTM Standard	Results
Flexural Stress	ASTM 0790	4,500 psi
Flexural Modulus of Elasticity	ASTM 0790	250,000 psi

2.3 MANHOLE LINER

- A. Resin: The resin shall consist of a corrosion resistant polyester or vinyl ester resin and catalyst system or an epoxy resin and hardener system that is compatible to the installation process and meets the requirements of ASTM F-1216, ASTM F-1743, or ASTM F-2019. Liner fabricated to match manhole dimensions for custom fit.
- B. Epoxy resin.
 - 1. Polyamide Bisphenol "A" Epichlorodhydrin for use with fiberglass liner.
 - 2. Modified epoxy resin for use with PVCP liner.
- C. Approved Manufacturers:
 - 1. Terre-Hill, Multi-Plexx Liner System.
 - 2. Poly-Triplex Technologies, Poly Triplex Liner System.
 - 3. Or Equal
- D. Spray on Epoxy Liners.
 - 1. Two or 3 part epoxy to protect concrete and steel from chemical attack.
 - 2. Minimum thickness.
 - a. Spray on epoxy: 60 mils.
 - b. Rotary spray on epoxy: 125 mils.
 - 3. Tensile Strength (ASTM C307): Minimum 2,500 psi.
 - 4. Flexural Strength (ASTM C580): Minimum 4,600 psi.
 - 5. Working time at 70 degrees F: 30 minutes.
 - 6. Initial set time at 70 degrees F: 17 hours.
 - 7. Approved Manufacturers:
 - a. Sauereisen, Sewer Gard No. 210, No. 210S or No. 210RS.
 - b. Raven, Raven 400S.
 - c. Terre Hill, Hydropoxy.
 - d. AP/M Permaform, Cor+Gard.
 - e. SprayRoq, Inc., SprayWall.
 - f. Or Equal.
- E. Concrete Protective Liners.
 - 1. High density Polyethylene (HDPE) concrete protective liner.
 - a. Integrally extruded with anchoring studs, minimum 39 studs per square foot.
 - b. Minimum thickness of liner sheet with anchoring studs: 2 mm.
 - c. Minimum thickness of flat liner sheet at joint overlaps: 3 mm.
 - d. Joints sealed using thermal welding.
 - e. Density (ASTM D792): 0.945 gm/cm³.
 - f. Elongation at Break (ASTM D638): Greater than 400 percent.
 - g. Minimum abrasion resistance (ASTM D4833): 160 pounds.
 - h. Steel profiles for mounting liner.
 - 1) Maintain minimum 2.5 inch annular space when filling with flowable concrete.
 - 2) Maintain minimum 1 inch annular space when filling with grout.

- 3) Anchor bolts: minimum penetration of concrete on manhole wall: 1.5 inches.
- 4) Countersink screws to mount liner to profiles.
- i. Cement in annular space.
 - 1) Minimum Compressive Strength: 4,000 psi at 28 days. Minimum aggregate size: 8 mm.
 - 2) Maximum aggregate size: 32 mm.
- j. Grout in annular space.
 - 1) Minimum Compressive Strength: 6,000 psi at 28 days.
 - 2) Low viscosity, high flowability to fill annular space without voids.
 - 3) Bonds to manhole wall.
- k. Approved Manufacturers:
 - 1) AGRU, Sure Grip Concrete Protective Liner.
 - 2) Or Equal.

F. Cast in Place Concrete Liner.

- 1. Formed in place seamless concrete manhole within the existing manhole, extending from bench to frame.
 - a. Structurally independent of existing manhole structure.
- 2. Concrete.
 - a. Type I/II Portland cement concrete.
 - b. Maximum Aggregate Size: 5/8 inch.
 - c. Fiber reinforcement and plasticizers to produce minimum compressive strength of 4,000 psi at 28 days.
- 3. Formwork.
 - a. Segmented forms in cylindrical and conical sections.
 - b. Allow adequate annular space for concrete.
 - c. Result in minimum finished manhole opening of 20 inches.
 - d. Sealed at bench and pipe openings to form water stop.
 - e. Removable from within new cast concrete manhole wall.
- 4. When specified, provide PVC or polyethylene liner on new interior manhole wall surface.
 - a. Minimum thickness: 0.065 inch.
 - b. Ribbed or studded for embedment into concrete.
 - 1) Minimum pull out strength: 100 pounds per linear inch. 3)
 - c. Fit securely to exterior of concrete forms.
 - d. Heat fuse or extrusion weld seams.
- 5. Approved Manufacturers:
 - a. AP/M Permaform, Permaform Liner.
 - b. Or Equal.

PART 3 - EXECUTION

3.1 CLEANING AND PRE-INSPECTION

- A. Contractor shall employ the appropriate traffic control measures and other worker safety precautions necessary to gain access to manhole and otherwise perform the work.
- B. Prior to entering access areas such as manholes, and performing inspection and cleaning operations, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen shall be undertaken in accordance with Local, State or Federal safety regulations.
- C. It shall be the responsibility of the Contractor to clean debris out of the pipe line prior to CIPP installation. For gravity pipes this shall be accomplished by jetting the line prior to construction. Collect and remove all debris extracted during the jetting process.
- D. Prior to beginning repair, Contractor shall inspect by closed-circuit television the entire pipe segment, manhole to manhole, to record the location of the repair(s) and active service connection(s). The video record in DVD format shall be furnished to the Contracting Officer for review along with the post-repair video. The video shall be high quality and in color.
- E. Prior to beginning repair, Contractor shall inspect by closed-circuit television the entire pipe segment, manhole to manhole, to record the location of the repair(s) and active service connection(s). The video record in DVD format shall be furnished to the Contracting Officer for review along with the post-repair video. The video shall be high quality and in color.
- F. Contractor shall clear the line of obstructions, solids, and dropped joints or collapsed pipe that will prevent the insertion of the liner. If inspection reveals an obstruction in the pipe that is outside of the entry shaft, the Contractor shall excavate to expose the pipe and eliminate the obstruction. Such excavation shall be approved in writing by the Contracting Officer prior to commencement of the work and shall proceed based on agreed upon pricing. If the obstruction can be removed by jetting, root cutting or other conventional cleaning methods, no additional pay item will be granted.

3.2 INSTALLATION PROCEDURE

- A. Contractor shall install the CIPP per the manufacturer's specifications and as described in the submitted documents.
- B. Contractor shall utilize the installation and monitoring equipment required and specified by the manufacturer to ensure the CIPP is installed correctly.
- C. The fabric tube shall be completely impregnated with resin prior to installation.
- D. The CIPP shall be fully inflated to conform to the existing sanitary sewer main.
- E. Curing of the resin may be accomplished by direct or indirect heating, application of steam, exposure to ultraviolet light, or other method per the manufacturer's specifications.

3.3 FINISHED PRODUCT

- A. The finished CIPP shall be continuous over the entire length of the installation and be free of dry spots, pinholes, lifts, delaminations, major wrinkles, areas of incomplete curing, or other defects. Where these conditions are present the CIPP shall be evaluated for its ability to meet the applicable testing requirements. Where the CIPP does not meet the testing requirements, the affected portions of the CIPP shall be removed and replaced at no additional cost to the Government.
- B. The finished CIPP shall comply with the standards listed in Part 1 and the material requirements listed in Part 2.

3.4 SERVICE CONNECTIONS

- A. After the new CIPP has been installed, the existing service connections shall be restored. This shall be done without excavation from the interior of the pipeline by the means of a television camera and a remotely controlled cutting device. Service connections shall be restored to at least 95% of the original area as it enters the host pipe or conduit. If the service cut performed is larger than the original area and it appears to affect the purpose of the lining. The Contractor shall repair the defective cut at no additional cost to the Government.
- B. Top Hat Service Lateral Sealing System.
 - 1. Resin Impregnation:
 - a. The resin impregnated tube shall be loaded inside a pressure apparatus. The pressure apparatus, attached to a robotic device, shall be positioned in the mainline pipe at the service connection. The robotic device, together with a television camera will be used to align the SLSS repair with the service connection opening. Air pressure, supplied to the pressure apparatus through an air hose, shall be used to invert the resin impregnated SLSS into the lateral pipe. The inversion pressure will be adjusted to fully invert the SLSS into the lateral pipe and hold the tube tight to the pipe wall. Care shall be taken during the curing process so as not to over-stress the tube.
 - b. The pressure apparatus shall include a bladder which will inflate in the mainline pipe, effectively sealing the SLSS repair against the service connection.
 - 2. Curing:
 - a. After inversion is completed, recommended pressure is maintained on the impregnated tube for the duration of the curing process. An ultraviolet (UV) light cured resin system must be used.
 - b. The initial cure shall be deemed to be completed when the SLSS has been exposed to the UV light or held in place for the time period specified by the manufacturer.
 - 3. Cool-Down:
 - a. The installer shall cool the hardened SLSS before relieving the pressure in the pressure apparatus. Cool-down may be accomplished by the introduction of cool air into the pressure apparatus. Care shall be taken to maintain proper pressure throughout the cure and cool-down period.

3.5 MANHOLE PREPARATION

- A. Establish Sewer Bypass Pumping if sewer collection system is determined to stay in operation by the Contracting Officer.
- B. Clean interior surfaces of manhole of debris, dirt, oil, grease, remains of old coating materials, and any other extraneous materials following approved submittals for rehabilitation products used.
- C. Pressure wash manhole walls to remove loose mortar, concrete, debris following approved submittals for rehabilitation products used.
- D. Repair irregularities in manhole following approved submittals for rehabilitation products used.
- E. Repair leakage in manhole following approved submittals for rehabilitation products used.
- F. Trim and grout incoming laterals and pipes following approved submittals for rehabilitation products used.
- G. Remove debris from manhole and sewer.
 - 1. Handle cleaning water in closed discharge hoses to prevent water and residue from causing damage.
 - 2. Do not discharge debris through sanitary sewer system.
 - 3. Filter solids-laden water through an approved desilting device.
 - 4. Dispose of residue from cleaning and other construction operations in a manner satisfactory to the Contracting Officer.

3.6 INSPECTION

- A. After the installation of the liner and before the flow bypass is removed, if required, the Contractor shall inspect by closed-circuit television the entire pipe segment, manhole to manhole, to record the location of the repair(s) and restored service connection(s).
- B. A video record in DVD format shall be provided to the Contracting Officer for review along with the pre-inspection video.
- C. The video shall be high quality and in color.
- D. The video shall be in the same direction, manhole to manhole, as the pre-inspection video.
- E. The video shall show all seams of the CIPP repair and the CIPP liner from invert to crown of pipe for the entire length of the repair. Speed of camera through repair should be slowed to allow for inspection of installation. If in the opinion of the Contracting Officer, the submitted video does not allow for inspection of the video, the installation shall be re-televised at no additional cost to the Government.

3.7 RETURN TO SERVICE

- A. Following the inspection, and provided no defects are noted, the Contractor may return the sanitary sewer main to service (i.e. remove the bypass). Return to service does not constitute acceptance by the Government, and the Contracting Officer reserves the right to review videos prior to granting acceptance of the work.

3.8 CLEANUP

- A. The Contractor shall provide all labor, equipment, and supervision to thoroughly cleanup all work sites at the completion of construction and dispose of all wastes properly.

END OF SECTION 330130

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SECTION 331100 - WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Additional information concerning water distribution systems may be found on the civil drawings. In case of conflict between the drawings and the information specified herein, the more stringent requirements shall govern.

1.2 SUMMARY

- A. This Section includes water-distribution piping and specialties outside the building for the following:
 - 1. Water services.
 - 2. Fire-service mains.
 - 3. Water mains.
 - 4. Fire hydrants.
- B. Work Included: Locating existing building connections that will be connected to new service or mainline piping. Excavation, exploratory excavation (pothole), backfill, bedding, soil stabilization, ground water removal, connection to existing mains, and installation of pipe, thrust blocks, thrust restraints, valves, fittings, valve boxes, and all necessary appurtenances. Also includes removal and replacement of existing paving or concrete where required, haul and import of adequate backfill material to meet compaction requirements and removal of existing thrust blocks where necessary. Includes abandonment of valves and existing mains as required.
- C. Related work:
 - 1. Division 01 Section "Archeological and Historic Resource Protection".
 - 2. Division 01 Section "Historic Preservation Treatment Procedures".
 - 3. Division 01 Section "Temporary Erosion and Sedimentation Control" for erosion and sedimentation control measures.
 - 4. Division 31 Section "Site Clearing" for temporary utilities and support facilities may be included.
 - 5. Division 31 Section "Earth Moving" for soil materials, site grading, site excavation and filling.
 - 6. Division 31 Section "Trenching and Backfilling" for excavating and backfilling of utilities.
 - 7. Division 31 Section "Asphalt Paving" pavement patching over trenches.
 - 8. Division 31 Section "Concrete Paving" for concrete structures, concrete materials and exterior concrete paving or walks.
 - 9. Division 32 Section "Water Treatment Equipment"

1.3 DEFINITIONS

- A. Fire-Service Main: Exterior fire-suppression-water piping for new fire hydrants.
- B. Water Service: Exterior domestic-water service piping.
- C. The following are industry abbreviations for pipe materials:
 - 1. PVC: Polyvinyl chloride plastic.
 - 2. CIP: Cast iron pipe.
 - 3. DIP: Ductile iron pipe.
 - 4. CU: Copper pipe.
 - 5. HDPE: High density polyethylene
- D. Trench Excavation: Excavation of all material encountered along trench other than rock excavation.
- E. Rock Excavation: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 3/4 cu. yd. for footing, trench, and pit excavation which in the contractor's Geotechnical Engineer's opinion cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- (1065-mm-) wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,090 lbf (125 kN) and stick-crowd force of not less than 18,650 lbf (83 kN); measured according to SAE J-1179.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Piping specialties.
 - 2. Fittings.
 - 3. Valves, valve boxes and accessories.
 - 4. Water meters and accessories.
 - 5. Protective enclosures.
 - 6. Fire hydrants.
 - 7. Insulation material.
- B. Field Quality-Control Test Reports: From Contractor.
- C. Test Reports: Submit two (2) copies of laboratory gradation tests for bedding and trench stabilization materials, concrete mix design, asphalt mix designs, and compression test.
- D. Locates: Contractor must submit two (2) copies of utility locate drawings/receipts prior to beginning construction.

- E. As-Builts: Provide the Contracting Officer with copies of redlined, as-built plans upon completion of construction. Horizontal and vertical information is to be certified by a Colorado Licensed Professional Land Surveyor.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, material, profiles, and dimensional requirements of piping and specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Regulatory Requirements:
 - 1. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Contracting Officer not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Contracting Officer's written permission.
- B. Historical Preservation: Except by specific written authorization, protect all existing site improvements deemed to be of historical significance. Disturbance of historical stone paths, walls, and related infrastructure shall be subject to approval by the Contracting Officer and shall be restored as indicated in the Contract Documents. Contractor is responsible for notifying the Contracting Officer a minimum of two (2) weeks prior to disturbance of said historic elements.
- C. Environmental Requirements: Except by specific written authorization, cease concreting when descending air temperature in shade and away from artificial heat falls below 35 degrees F. and there is frost in subgrade. When concreting is permitted during cold weather, temperature of mix shall not be less than 60 degrees F. at time of placing.
- D. Immediately pump or bail out water found in excavations, whether rain or seepage. Coordination and use of electric power is the Contractor's responsibility. Excavations must be kept free from water at all times.
- E. It shall be the responsibility of the Contractor to take all measures and furnish all equipment and labor necessary to control the flow, drainage and accumulation of water as required to permit completion of the work under this section to avoid damage to all work at no additional cost to the Government.
- F. It shall be the responsibility of the Contractor to take all measures and furnish all material, equipment and labor necessary to provide adequate backfill material as specified herein.

1.8 PROJECT RECORD DOCUMENTS

- A. Maintenance of Documents: Store documents apart from drawings used for construction. File submitted documents in accordance with the specification's section numbers. Maintain documents in a clean, dry legible condition and in good order. Do not use record documents for construction purposes.

- B. Recording: Label each document "PROJECT RECORD" in neat, large, printed letters. Record information concurrently with construction progress. Do not cover work until required information is recorded. Marking of project records shall be legible and with a dark pen or pencil. Ink shall not be water based due to easy smearing. Mark drawings to record actual construction including field dimensions, elevations, details, changes made by a modification, details not on original drawings, horizontal and vertical locations of underground utilities and appurtenances referenced to a minimum of two permanent surface improvements, and depths of various elements of work in relation to project datum. All horizontal and vertical information is to be certified by a licensed Colorado Professional Land Surveyor.
- C. Submission: Accompany submittal with transmittal letter in duplicate containing date, project title and number, Contractor's name, address and telephone number, title and number of each record document, and signature of Contractor or his authorized representative. Contractor shall submit two drawings and certified by a licensed Professional Land Surveyor depicting all as-built information to the Contracting Officer.

1.9 PROTECTION

- A. Park Resources: Limit damage and impacts to natural and cultural resources within the project limits and as directed by the Contracting Officer. Coordinate with the Contracting Officer and his/her compliance resource staff prior to construction activities within undisturbed areas to mitigate impacts from equipment, materials storage, and other construction activities. Contractor shall clarify at the time of bid limitations on construction activities and equipment that can be used to perform the work within the project limits.
- B. Barricades and Safety Provisions: Place and maintain until completion of work adequate barricades, construction signs, warning lights and guards to avoid property damage and protect persons from injury. Flares with open flames will not be permitted. Protect all materials, equipment, pipe and earth piles that may serve as hazards to vehicular or pedestrian traffic by barricades or guards and warning lights.
- C. Shoring: Provide and maintain all sheeting, shoring and bracing required to safely retain earth banks. Protect adjoining grades and structures from caving, sliding, erosion or other damage, and suitable forms of protection against bodily injury; all in accordance with applicable codes and governing authorities.

Do not remove any sheeting unless the pipe strength is sufficient to support the trench loads based on trench width measured to the back of sheeting. Remove sheeting and shoring gradually as excavation backfilling progresses to protect the construction or other structures, utilities or property. Do not attempt removal of sheeting in one operation after backfilling is complete.

- D. All work must comply with latest OSHA requirements.
- E. Utilities: Protect from damage existing utility lines shown on drawings or locations of which are made known to contractor prior to work and utility lines constructed during construction operations of the project. Hand excavate within six inches of known piping or objects to prevent damage from equipment. Before commencing work, obtain information concerning location,

type, and extent of concealed existing utilities on the site and adjacent properties. Repair damage to utilities at no cost to the Government.

- F. Granular Fill: Protect existing granular fill adjacent to existing structures from dirt that would impede free drainage. Remove and replace any portions of granular fill that become contaminated with dirt.
- G. Drainage: Maintain the excavations and site free from water throughout the work. Remove any water encountered in the trench to provide firm subgrade, to permit joints to be made dry at the final grade, and to prevent entrance of water into the pipeline. Accomplish the foregoing by the use of sumps and gravel blankets, well points, or drainlines. Contractor shall obtain all permits associated with dewatering.

Rock, gravel, and other appurtenances used to keep trenches free from water or used to add support to installed piping is considered incidental to construction and all costs shall be the responsibility of the Contractor.

- H. Survey Control Monuments and Range Boxes: Protect existing survey control monuments from damage. Contractor will be responsible for replacement or repair of any monument damaged or destroyed. Replacement of monuments must be performed by a qualified land surveyor.

1.10 COORDINATION

- A. Coordinate connection to water treatment facility piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. PE Pipe and Fittings: High Density Polyethylene (HDPE) Pipe and Fittings
 - 1. 2-inch and smaller HDPE Pipe, SDR 7, 333 psi
 - a. HDPE plastic pipe shall be PE-4710 resin meeting ASTM D3350 cell classification 445574C, DR 17, 125 psig minimum pressure rating and comply dimensionally with ASTM D3035, iron pipe size (IPS), compatible with heat fusion.
 - b. Pipe shall be manufactured in accordance with AWWA C901 for sizes ½” through 3”, NSF 61 certified.
 - c. HDPE shall be provided in rolls whenever rolls are available in specified pipe size.
 - d. The joining method shall be fusion method and shall be performed in strict accordance with the pipe manufacturer’s recommendations. Butt fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer, including but not limited to, temperature requirements, alignment, and fusion pressures. Ribbed steel inserts with stainless steel clamps are not approved for HDPE pipe.
 - e. The HDPE pipe shall be Driscoplex 5100 Ultra-Line Pipe as manufactured by Performance Pipe, Plano, TX, 75093, (800) 527-0662, www.performancepipe.com or approved equal.

2. HDPE Fittings
 - a. ASTM D 3350, PE resin material meeting the same dimensions, class and pressure requirements as the pipe.
 - b. Molded fittings shall be ASTM D3261 manufactured for butt fusing and shall be so marked.
HDPE fittings shall be molded or fabricated by George Fischer Central Plastics, Shawnee, OK, 74804, (800) 654-3872, www.centralplastics.com or approved equal.

B. Ductile-Iron Pipe and Fittings [sizes 3-inches – 42-inches]

1. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, thickness Class 52 with cement-mortar lining, AWWA C104 with mechanical-joint, bell- and plain-spigot end.
 - a. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, pressure rating 250 psi, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - b. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and high-strength, low alloy steel bolts such as Cor-Ten.
 - c. All fittings cement – mortar lined, AWWA C104.
 - d. Bituminous outside coating one mil thick.

2.2 PIPING SPECIALTIES

A. Dielectric Fittings: Combination of copper alloy and ferrous; threaded, solder, or plain end types; and matching piping system materials.

1. Dielectric Unions: Factory-fabricated union assembly, designed for 250-psig minimum working pressure at 180 deg F. Include insulating material that isolates dissimilar metals and ends with inside threads according to ASME B1.20.1.

B. Mechanical Joint Restraint

1. General: All mechanical joint restraints shall be incorporated in the design of a follower gland. The gland shall be manufactured of ductile iron conforming to ASTM A536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to AWWA C111 and C153.
2. Description: The restraint mechanism shall consist of numerous individually activated gripping surfaces to maximize restraint capability. The gripping surfaces shall be wedges designed to spread the bearing surfaces on the pipe. Twist-off nuts, sized same as tee-head bolts, shall be used to insure proper actuating of restraining devices. When the nut is sheared off, a standard hex nut shall remain.
3. Pressure: The mechanical joint restraint device for ductile iron pipe shall have a working pressure of at least 250 psi with a minimum safety factor of 2.
The mechanical joint restraint device for PVC shall have a working pressure of at least 150 psi with a minimum safety factor of 2:1.
Acceptable Manufacturer: The mechanical joint restraint devices shall be of the type listed below or equal.

EBA Iron, Inc.	Megalug 1100 series	(4-inches – 36-inches)
Uni-Flange	Series 1400	(4-inches – 36-inches)

C. Foamular Insulation Board

1. General: Insulation board shall be foamular XPS in accordance with ASTM C578, Type VI.

2.3 TRACER WIRE

A. As indicated on the drawings, install tracer wire on all non-ferrous water distribution piping and service laterals.

1. Wire: Minimum #12 AWG solid copper wire with 0.03 inch blue colored PE insulation.
2. PVC tape, 2-inch wide.
3. Locator wire test sites: Two terminal, switchable lid manufactured of non-corrosive, injection molded resin. Base material shall be high-grade ABS rigid plastic in accordance with ASTM D1788, Type 1. Use SnakePit Access Points by Copperhead Industries, or approved equal. Provide stamped aluminum label secured to inside of lid indicating utility that test site is connected to.

2.4 CORROSION-PROTECTION ENCASUREMENT FOR PIPING

A. Encasement for Underground DIP and CIP Piping: AWWA C105, PE film, Type I, Class A, Grade E-1 (ASTM D1248), 1200 lbs per square inch minimum tensile strength, 300% elongation, 800 v/mil thickness minimum dielectric strength, minimum thickness, tube or sheet.

2.5 GATE VALVES AND ISOLATION VALVES

A. Gate Valves: Less than 3-inches

1. All gate valves under 3-inches for use with HDPE pipe shall be all bronze, with non-rising stems and solid wedge disc. The valve shall be rated at 200 psi. Gate valves shall be of the type listed below or equal, and approved by jurisdiction agency.

Red & White	#206	(3/4")
Red & White	#207	(1")
Kitz	#27	(3/4")
Kitz	#28	(1")
Hammond	#668	(3/4")
Milwaukee	#105	(3/4")

B. Ball Valves: Less than 3-inches

1. All ball valves under 3-inches for use with HDPE pipe shall be all bronze, full port ball valve, 400 psi. Ball valves shall be of the type listed below or equal, and approved by jurisdictional agency.

Appollo	#95-104	(3/4")
Ford	#B22, #B44	(3/4-inches – 1-inch)
Red & White	B5049, #5063	(3/4-inches – 1-inch)

2. Nonrising-Stem, Resilient-Seated Gate Valves: AWWA C509, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut. Valve stem shall have a minimum yield strength of 40,000 psi, minimum elongation of 2-inches of 12%, and shall be per ASTM A276, type 304 or 316; or AISI 420. Wrench nuts in accordance with 4.11 of AWWA C509. Stem seal shall consist of two (2) O-rings in accordance with Section 4.8 of AWWA C509. The valves shall open by turning to the right.
 - a. Minimum Working Pressure: 200 psig.
 - b. End Connections:
 - 1) Mechanical Joint: All components of this type of joint shall conform to AWWA C111. The tee-head bolts and hexagon nuts shall be fabricated from a high-strength, low alloy steel known in the industry as Cor-Ten Usalloy, ductile iron Durabolt or equal.
 - c. Interior Coating: Complying with AWWA C550.
 - d. Bolting Material: Bonnet and gland bolts and nuts shall be either fabricated from a low alloy-steel for corrosion resistance or electro-plated with zinc or cadmium. The hot-dip process in accordance with ASTM A153 is not acceptable.

2.6 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include extension of length required for depth of burial of valve, plug with lettering "WATER,". Valve boxes shall be the three-piece adjustable screw type. The top section shall be 16-inches long. The following pattern is acceptable.
 1. Tyler screw-type 6-inch cast iron valve box assembly series 6860 with No. 160 oval base.
 2. D & L Supply Series M-9000 with No. 160 oval base Sigma Model No. VB630.
 3. Star Pipe Model No. VBD160DMWW
 4. Western States Pipe Model No. VBDEN
 5. Olympic Foundry Inc. Model No. 450VB
 6. Castings Inc. CI. 160B Oval Base
 7. Or approved equal
 8. Operating Wrenches: Contractor to provide one steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.7 CURB VALVES

- A. Manufacturers:
 1. Corp Stop Curb Stop
 2. Ford Meter Box Company, Inc. (The). F-600, FB600 B-22
 3. Grinnell Corporation; Mueller Co.; Water Products Div. H-15000 H-15204
 4. Jones, James Company. J-1500 J-1902,J-1901
 5. Hays 5200 4304
 6. McDonald, A. Y. Mfg. Co. 4701 6100
 7. Cambridge Brass 102202
 8. Manufacture pre-approved by agency having jurisdiction.

- B. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material (copper to copper).
- C. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," bottom section with base of size to fit over curb valve, and approximately 3-inch diameter barrel. Manufacturer Tyler 6500 Series, 5-foot extension, 94E stop box Buffalo Type or D&K M-9081 and M-9082; for 1 ½ - 2-inch Tyler 6870 Series, 4 ¼-inch shaft.
 - 1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.8 WATER METERS

- A. Water meters shall be as specified in Division 22 Section "Domestic Water Piping".

2.9 YARD HYDRANTS

- A. Frostproof Yard Water Hydrants

- 1. Description: Freestanding frost proof yard hydrants with hose connection backflow preventer.
 - a. Sanitary: Frostproof water release is via a Piston-Actuated or Venturi System. Weep holes are not allowed.
 - b. Safety: Lead Free
 - c. Pressure Rating: Minimum 20 psi, Maximum 100 psi
 - d. Accessible: Meets ABAAS requirements for height and maximum 5lb operating force.
 - e. Frostproof hydrant shall be Woodford S4H as manufactured by Woodford Manufacturing Company, Colorado Springs, CO, 80915, (800) 621-6032, <https://www.woodfordmfg.com> or approved equal.

2.10 FREESTANDING FIRE HYDRANTS

- A. Dry-Barrel Fire Hydrants: AWWA C502, one NPS 4-1/2 and two NPS 2-1/2 outlets located at least 18-inches above ground, 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Complete with plain rubber gasket, gland, bolts and nuts per AWWA C111. Bolts and nuts to be high strength low alloy corrosion resistant steel Cor-Ten minimum yield 50,000 lbs per square inch ASTM A242. Include two (2) lugs into bore for rodding of pipe. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure, and 150-psig minimum working-pressure design.
- B. Main Valve Assembly: Main valve of the hydrant shall be the compression type which closes with the water pressure. Seat ring shall be bronze with a machined face and external threads for threading into a bronze drain ring, or a bronze bushed shoe to provide bronze to bronze seating for the main valve. The assembly shall be sealed with O-rings.

Main valve shall be replaceable type fabricated of a resilient material with a threaded bottom plate or nut with a seal to prevent leakage of the hydrant shaft. The upper valve plate material shall be either bronze or epoxy coated ductile iron.

The valve assembly shall include one or more drain valves which will work automatically with the main valve and drain the barrel when the main valve is in the closed position. All drain tubes shall be bronze lined and sized large enough for the barrel to drain within 12 minutes when the barrel is sized for a 5-foot trench depth.

All parts of the main valve assembly shall be so designed that removal of the assembly from the barrel is accomplished without excavation in accordance with AWWA C502 3.4.1.

- C. Operating Shaft and Nut: The bronze operating nut shall be bronze or ductile iron and shall be pentagon shaped with a finished height of 1 1/8-inch. The dimensions from point-to-flat shall be between 1 1/4-inch and 1 3/8-inch from the top and to the bottom of the nut. Bushings in bonnet shall be so constructed that it will prevent the operating nut from traveling during opening or closing operation. Also the bushing shall house a gasket or seal to prevent moisture or foreign material from entering the lubricant reservoir.

All hydrants shall be grease lubricated or shall be the dry-top design where an oil reservoir provides permanent lubrication of the operating nut threads.

A stop nut located in the hydrant bonnet on the operating shaft shall prevent over travel of the main valve when being opened.

The hydrant shall open by turning the operating nut to the right in a clockwise direction and shall have an arrow on top of the bonnet to designate the direction of opening.

- D. Nozzle Attachment: Outlet nozzles shall be fastened into the barrel by mechanical means and secured by a stainless steel pin or screw, bronze wedge or a ductile iron retainer. Nozzles shall be sealed by the use of O-rings.
- E. Color: The upper exposed section of the hydrant above ground shall be thoroughly cleaned and then painted with a prime coat of a rust inhibitive primer followed by a 10-mil thick shop coat of heavy duty alkyd enamel paint. The paint color shall be yellow similar to Federal Color No. 13538.

All exposed exterior surfaces below the ground line shall be coated with asphalt varnish or equal in accordance with 4.2.3 of AWWA C502.

The interior of the hydrants shall be coated with an epoxy coating in accordance with 4.2.4 of AWWA C502. The epoxy paint shall be NSF 61 approved.

- F. Traffic Features: All hydrants shall be equipped with traffic features that include a break away flange or lug system with a shaft coupling.
- G. Acceptable Brands: The following four (4) brands of fire hydrants as described below will be considered as equal products. Any offers for other brands or model numbers will be rejected.

Manufacturer* Model No.

American Valve and Hydrant B-84-B

A Division of American Cast

Iron Pipe Company Mueller Company Centurion

Mueller Company Centurian 423 (outside Denver)

Waterous Company Pacer – WB-67-250

United States Pipe and Foundry Company Metropolitan 250 M-94

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Refer to Division 31 Section "Trenching and Backfilling" for excavating, trenching, and backfilling.
- B. Exploratory Excavation: It shall be the Contractor's responsibility to excavate and locate all existing utilities which may affect construction of the water facilities. All exploratory excavations shall occur far enough in advance to permit any necessary relocation to be made with minimum delay and to verify existing vertical and horizontal location to determine alignment for the proposed water line. All costs incurred by the Contractor in making exploratory excavations shall be considered to be included in the unit price bid for constructing each section of water line or the associate structures.
- C. Unstable Trench Bottom

Where trench does not have sufficient strength to support pipe and bedding, or stream crossings are encountered, use one of following methods to repair trench bottom as approved by the Contracting Officer. A minimum depth of repair is 2-feet.

- 1. Embankment: Clear and strip existing surface of all unacceptable material. Place embankment material agreed to by the Contracting Officer, compact to 95% AASHTO T99.
- 2. Aggregate Trench Bottom, percent by weight passing square mesh sieves: 1-½", 90-100; ¾", 50-90; No. 4, 30-50; No. 200, 3-12.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- C. Do not use flanges, unions, or keyed couplings for underground piping.

- D. Flanges, unions, keyed couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

3.3 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:

1. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
2. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

- B. Pipe Jointing:

1. General: Cut pipe for inserting valves, fittings, or closure pieces in neat and workmanlike manner with no damage to pipe or lining. Leave smooth end at right angles to axis of pipe.
2. Mechanical Joints: Thoroughly clean last 8-inches of spigot and inside bell to remove oil, grit, tar, and other foreign matter. Coat spigot and gasket with solution furnished by pipe manufacturer. Slip cast-iron gland on spigot end of pipe with lip extension of gland toward spigot end. Coat gasket with joint lubricant and place on spigot end of pipe to be laid, with thick edge toward gland.

Push entire section forward to seat spigot in bell of pipe in place. Press gasket into place within bell, even around entire joint. Move ductile-iron gland along pipe into position for bolting all nuts with suitable torque wrench. Alternately tighten nuts 180 degrees apart to produce equal pressure on all parts of gland.

Pipe Size Inches	Bolt Size Inches	Range of Torque Ft.-Lb.
3"	5/8	45 - 60
4"-24"	3/4	75 - 90

3. Push-on Joints: Thoroughly clean exterior 4-inches of pipe spigot and inside of adjoining bell to remove all oil, grit, tar, and other matter. Place gasket in bell with large round side of gasket pointing inside pipe bell. Apply thin film joint lubricant over gasket's entire exposed surface. Wipe spigot end of pipe clean and insert into bell to contact gasket. Force pipe into bell to manufacturer's jointing mark.
4. Flanged Joints: Thoroughly clean faces of flanges of all oil, grease, and other material. Thoroughly clean rubber gaskets and check for proper fit. Assure proper seating of flanged gasket. Tighten bolts so pressure on gasket is uniform. Use torque wrenches to insure uniform bearing. If joints leak when hydrostatic test applied, remove and replace gaskets and retighten bolts.

- C. Thrust Restraint: Install in accordance with the drawings. Removal of existing thrust blocks and rodding is the sole responsibility of the Contractor. Any damage caused by the removal of thrust blocks, regardless of size, or rodding shall be paid for by Contractor.

3.4 PIPING INSTALLATION

- A. General: Deliver, handle, store, and install in accordance with the pipe manufacturer's recommendations and the applicable paragraphs of AWWA C600, AWWA C603, and ASTM D2321.

Carefully examine all pipe and fittings for cracks and other defects. Groove in bells of ductile iron pipe to be full and continuous or be rejected. Remove all foreign matter from interior and ends of pipe and appurtenances before lowering into trench. Carefully lower all pipe, fittings, valves, and hydrants into trench piece by piece to prevent damage to pipe materials, protective coatings, and linings. Do not dump into trench. If pipe cannot be lowered into trench and into place without getting earth into it, place heavy, tightly woven canvas bag over each end and leave in place until joints are made. During pipe laying, place no debris, tools, clothing or other materials in pipe.

Keep trenches free from water during pipe laying and jointing. Dewatering of trench considered as incidental to construction and all costs included in contract prices. When pipe laying is not in progress, close open ends of pipe by watertight plug, or other means approved by the Contracting Officer.

Dewatering shall be accomplished by the use of well points, sump pumps, rock or gravel drains placed below subgrade foundations or subsurface pipe drains. All water shall be disposed of in a suitable manner without being a menace to public health or causing public inconvenience. No water shall be drained into other work being completed or under construction. Obtain all necessary permits for dewatering.

The dewatering operation shall continue until such time as it is safe to allow the water table to rise in the excavations. Pipe trenches shall contain enough backfill to prevent pipe floatation.

Water shall not be allowed to rise until the concrete has set a minimum of twenty-four (24) hours, and the forms have been removed. Water shall not be allowed to rise unequally against unsupported structural walls.

- B. Deflection of Pipe: Do not exceed deflection limits for each type of pipe as recommended by pipe manufacturer. Do not deflect pipe at start joint.
- C. Install AWWA pipe according to AWWA M23 and ASTM F 645.
- D. Bury piping with depth of cover over top of pipe at least 72-inches.
- E. Extend water-service piping and connect to water-supply source and existing building water piping systems at outside face of building wall in locations and pipe sizes indicated.
1. Do not install water-service piping until existing building water piping systems are located. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building water piping systems when those systems are located.
- F. Install underground piping greater than 2-inches with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and supports.

3.5 TRACER WIRE INSTALLATION

- A. Tracer wire shall be installed the full length of buried pipe and shall terminate at test stations to be located as directed by the Contracting Officer.
 - 1. Attach tracer wire to pipe with 2-inch-wide PVC tape around circumference of pipe diameter.
 - 2. Splice wire in accordance with the manufacturer's recommendations.
 - 3. Leave 3 feet of slack wire in test site.
 - 4. In the presence of the Contracting Officer, verify continuity of the tracer wire.
 - 5. Locate test sites a minimum of 500 feet from each other and in a location easily accessible and outside of vehicular ways, preferably adjacent to line valves.

3.6 PIPING INSULATION

- A. Install insulation over and around water piping where indicated on the drawings or where the depth of cover is less than 72 inches.
 - 1. Where water piping is installed with less than 72 inches of cover, install minimum one inch of insulation material for every 12-inches of cover that cannot be provided.

3.7 ANCHORAGE INSTALLATION

- A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
- B. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVES AND HYDRANTS

- A. Carefully inspect valve and hydrant before installation. Clean interior. Operate valve and hydrant to determine parts in proper working order, with valves seating and drain valve operating properly. Set plumb and securely brace into place. Set hydrant with bury line at finish grade, with hose nozzles parallel to and pumper nozzle facing pavement, at least 6-inches behind curb or sidewalk and 18-inches from property line or as shown on drawings. Provide drainage pit having 9 square feet of surface area and 2' of depth below seep hole. Backfill pits with 1-1/2-inches washed rock to 6-inches above barrel drain hole. Provide thrust blocking at bowl of each hydrant as shown on drawings. Do not obstruct barrel drain hole. Hydrants and valves backfilled by installing 1-1/2-inches aggregate road base to subgrade. Valve boxes centered and plumb over the operating nut. Valve boxes supported by bricks or other means to prevent any shock or stress transmitted to pipe or valve. Set valve box covers to just below subgrade level to prevent damage during construction of surfacing if applicable. Adjust to grade of surfacing.
- B. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

- C. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.9 SANITARY SEWER CROSSING

- A. Normal conditions: Whenever possible lay water mains over sanitary sewers to provide vertical separation of at least 18-inches between invert of water main and crown of sewer.
- B. Unusual Conditions: If above separation cannot be met, use following:
 - 1. Sewer passing over or less than 18-inches under water main.
 - a. One continuous length of watertight pipe 20' long centered on water main. Joints between different pipes encased in concrete 6-inches thick and extending 6-inches either side of joint: or
 - b. Sewer pipe encased in 6-inches concrete around pipe, and extend 10' either side of water main.
 - 2. Water mains passing under sewers: If vertical separation less than 18-inches provide structural support for sewer.

3.10 UTILITIES ENCOUNTERED

- A. Protection of all existing gas, water, sewer services, drains, cable, telephone lines and electric lines encountered during construction is the Contractor's responsibility. If utilities are disturbed, they shall be maintained and/or restored to original condition at the Contractor's expense. Backfill around utilities shall be adequately compacted to assure permanent stability.

3.11 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Notify Contracting Officer at least 24 hours in advance of pipe being laid in any trench. Cover no pipes until observed by the Contracting Officer. Notify the Contracting Officer at least 48 hours before pipe is to be tested. All water mains are to be disinfected, flushed, and hydrostatically tested per CDPHE Regulations.
- C. Hydrostatic Testing HDPE Pipe
 - 1. Hydrostatic testing shall be performed in accordance with ASTM F2164.
 - 2. Hydrostatic leak testing may be conducted on the full system, or in sections. The test liquid shall be potable water.
 - 3. Maximum permissible test pressure is measured at the lowest elevation in the test section.
 - 4. Maximum permissible test pressure is the lower of:
 - a. 150% of the system design operating pressure provided that all components in the test section are rated for the test pressure, or

- b. the pressure rating of the lowest pressure rated component in the test section.
- 5. Test pressure must be reduced in elevated temperatures (above 90 degrees F) as per manufacturer's recommendations
- 6. Gradually pressurized the test section to test pressure of 150% of the system design pressure, and maintain test pressure for three (3) hours during initial expansion phase while PE pipe expands
- 7. Test Method: Immediately following the initial expansion phase, reduce test pressure by 10 psi, and stop adding test liquid. If test pressure remains steady (within 5% of the target value) for one (1) hour, no leakage is indicated.
- 8. Prepare reports of testing activities and submit to the Contracting Officer within three (3) days of completion of testing.

D. Hydrostatic Testing of Ductile Iron Pipe:

- 1. General: Make pressure and leakage tests on all newly laid pipe. Test two or more valved sections not to exceed 1000 feet. Test first section of pipe laid to verify if watertight. Lay no additional pipe until first test section has passed tests.
- 2. Furnish following equipment and materials for tests, unless otherwise directed by the Contracting Officer:
 - 1 Graduated containers
 - 2 Pressure gauges
 - 1 Suitable hose and suction pipe as required
- 3. Testing Procedure: Test each 1000 feet of line installed while trench is partially backfilled and joints are left exposed for examination for leaks. Do not conduct pressure tests until 48 hours after placement of concrete thrust blocks. After pipe has been partially backfilled, slowly let water into line. Vent to allow air in line to be released. Flush line as necessary for cleaning. Leave water in line for 24 hours prior to pressure test. Test at 1-1/2 times working pressure, calculated for low point of test section, or 150 psi, whichever is greater. Valve off pump and hold pressure in line for test. Test for two hours or as agreed to by the Contracting Officer. At end of test, operate pump until test pressure is again attained. Calibrate container of water for pump suction to determine amount of water to replace leakage.
- 4. Leakage Allowance: Leakage is quantity of water necessary to refill line at end of test period. No installation will be accepted until leakage is less than:

ALLOWABLE LEAKAGE PER 1000' OF PIPE IN GPH

Avg. Test Pressure psi	Nominal Pipe Diameter - in.				
	6	8	10	12	18
200	0.64	0.85	1.06	1.28	1.91
175	0.59	0.80	0.99	1.19	1.79
150	0.55	0.74	0.92	1.10	1.66
125	0.50	0.67	0.84	1.01	1.51
100	0.45	0.60	0.75	0.90	1.35

For pipe with 18' nominal lengths. To obtain recommended allowable leakage for pipe with 20' nominal lengths, multiply the leakage calculated from the table by 0.9. If pipeline under test contains sections of various diameters, allowable leakage will be sum of computed leakage for each size. Reduce allowable leakage proportionately for sections less than 1000 ft.

- E. Prepare reports of testing activities.

3.12 FLUSHING AND DISINFECTING

- A. General: In accordance with AWWA C601. Acceptable chlorine disinfectants are calcium hypochlorite granules, sodium hypochlorite solutions, and calcium hypochlorite tablets.
- B. Chlorine-Water Solution Method:

Chlorine Required to Produce 25 Mg/L Concentration
in 100 feet of Pipe - by Diameter

Pipe Diameter In.	100 Percent Chlorine Lb.	1 Percent Chlorine Solution Gal.
4	.013	.16
6	.030	.36
8	.054	.65
10	.085	1.02
12	.120	1.44
16	.217	2.60

Induce chlorine solution into pipe line at a continuous feed rate to attain a concentration of 25 Mg/L free chlorine.

- C. Tablet Method: May not be used on solvent welded plastic pipe. May be used only when all foreign materials have been kept out of pipe. If ground water has entered pipe during installation and tablets have been installed, flush main and use chlorine-water solution method. Do not use if temperature is below 5 degrees C. Place tablets with non-toxic adhesive in each pipe length in top of pipe in accordance with following table:

Number of 5-g Hypochlorite Tablets
Required for Dose of 25 mg/L*

Pipe Diameter in.	Length of Pipe Section, ft.				
	13 or less	18	20	30	40
2	1	1	1	1	1
6	1	1	1	2	2

- D. Chlorination Test: Assure valves are closed on existing system to prevent chlorine solution flowing into existing system. Retain 25 mg/L chlorinated water in pipe line for minimum of 24 hours. During retention period operate all valves and hydrants to disinfect. At end of 24 hour period, chlorine in system to be no less than 10 mg/L throughout length tested. When section being tested meets 10 mg/L chlorine after 24 hours, flush main. Water samples taken shall show no coliform organisms. If water in pipe does not meet the governing health agency requirements, repeat disinfection procedure, at Contractor's expense, until requirements are met. Furnish acceptance forms from governing agency to the Contracting Officer.

3.13 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-service piping. Locate below finished grade, directly over piping. See Division 31 Section "Trenching and Backfilling" for underground warning tapes.

3.14 OPERATION OF VALVES

- A. Contractor is responsible for operating any valves necessary to complete project. Contractor is required to provide the Contracting Officer 24 hours notice prior to said operation.

3.15 CLEANUP AND RESTORATION

- A. Restore all pavements, curbs, gutters, utilities, fences, irrigation ditches, yards, lawns, and other structures or surfaces to condition equal to or better than before work began, and to satisfaction of the Contracting Officer. Deposit all waste material in designated waste areas. Grade and shape disposal site. Complete topsoil and reseeding of site, if required. Where disposal sites are not designated, remove and dispose of all waste material off site.

END OF SECTION 331100

*Based on 3.25 g available chlorine per tablet, any portion of tablet rounded to next higher number.

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SECTION 333100 - SANITARY UTILITY SEWERAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Work Included: Locating existing building connections that will be connected to new service or mainline piping. Removal of existing manholes and piping, , and installation of pipe, manholes, service wyes, cleanouts, service lines, testing, and all necessary appurtenances and safety precautions. This section includes gravity-flow sanitary sewerage outside the building, with the following components:

1. Cleanouts.
2. Precast concrete manholes.

- B. Related Sections:

1. Division 01 Section "Archeological and Historic Resource Protection".
2. Division 01 Section "Historic Preservation Treatment Procedures".
3. Division 01 Section "Temporary Erosion and Sedimentation Control" for erosion and sedimentation control measures.
4. Division 31 Section "Site Clearing" for temporary utilities and support facilities may be included.
5. Division 31 Section "Earth Moving" for soil materials, site grading, site excavation and filling.
6. Division 31 Section "Trenching and Backfilling" for excavating and backfilling of utilities.
7. Division 32 Section "Asphalt Paving" pavement patching over trenches.
8. Division 33 Section "Cured-In-Place Pipe (CIPP)" for sanitary sewer pipe lining.
9. Division 33 Section "Onsite Wastewater Treatment System"

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Submit shop drawings or product data showing specific dimensions and construction materials for pipe, fittings, and manholes or certifications that products conform with specifications.
- B. Test Reports: Submit all field quality control test reports.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic pipe and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by the Government or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Contracting Officer no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without written permission.
- B. Historical Preservation: Except by specific written authorization, protect all existing site improvements deemed to be of historical significance. Disturbance of historical stone paths, walls, and related infrastructure shall be subject to approval by the Contracting Officer and shall be restored as indicated in the Contract Documents. Contractor is responsible for notifying the Contracting Officer a minimum of two (2) weeks prior to disturbance of said historic elements.
- C. Environmental Requirements: Except by specific written authorization, cease concreting when descending air temperature in shade and away from artificial heat falls below 35 degrees F., and there is frost in subgrade. When concreting is permitted during cold weather, temperature of mix shall not be less than 60 degrees F at time of placing.
- D. Immediately pump or bail out water found in excavations, whether rain or seepage. Coordination and use of electric power is the Contractor's responsibility. Excavations must be kept free from water at all times.
- E. It shall be the responsibility of the Contractor to take all measures and furnish all equipment and labor necessary to control the flow, drainage and accumulation of water as required to permit completion of the work under this section to avoid damage to all work at no additional cost to the Government. Contractor is responsible for discharge permit as required by local or State jurisdiction.

1.7 PROJECT RECORD DOCUMENTS

- A. Maintenance of Documents: Store documents apart from drawings used for construction. File submitted documents in accordance with the specifications' section numbers. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
- B. Recording: Label each document "PROJECT RECORD" in neat, large, printed letters. Record information concurrently with construction progress. Do not cover work until required information is recorded. Marking of project records shall be legible and with a dark pen or pencil.

Ink shall not be water based due to easy smearing. Mark drawings to record actual construction including field dimensions, elevations, details, changes made by a modification, details not on original drawings, horizontal and vertical locations of underground utilities and appurtenances referenced to a minimum of two permanent surface improvements, and depths of various elements of work in relation to project datum. All horizontal and vertical information is to be certified by a licensed Colorado Professional Land Surveyor.

- C. Submission: Accompany submittal with transmittal letter in duplicate containing date, project title and number, Contractor's name, address and telephone number, title and number of each record document, and signature of Contractor or his authorized representative. Contractor shall submit two drawings and certification of data by a Professional Land Surveyor depicting all as-built information to the Contracting Officer.

1.8 PROTECTION

- A. Park Resources: Limit damage and impacts to natural and cultural resources within the project limits and as directed by the Contracting Officer. Coordinate with the Contracting Officer and his/her compliance resource staff prior to construction activities within undisturbed areas to mitigate impacts from equipment, materials storage, and other construction activities. Contractor shall clarify at the time of bid limitations on construction activities and equipment that can be used to perform the work within the project limits.
- B. Barricades and Safety Provisions: Place and maintain until completion of work adequate barricades, construction signs, warning lights and guards to avoid property damage and to protect persons from injury. Flares with open flames will not be permitted. Protect all materials, equipment, pipe, and earth piles that may serve as hazards to vehicular or pedestrian traffic by barricades or guards and warning lights.
- C. Utilities: Protect from damage existing utility lines shown on drawings or locations of which are made known to contractor prior to work, and utility lines constructed during construction operations of the project. Hand excavate within 6-inches of known piping or objects to prevent damage from equipment. Before commencing work, obtain information concerning location, type, and extent of concealed existing utilities on the site and adjacent properties. Repair damage to utilities at no additional cost to the Government.
- D. Drainage: Maintain the excavations and site free from water throughout the work. Remove any water encountered in the trench to provide firm subgrade, to permit joints to be made dry at the final grade, and to prevent entrance of water into the pipeline.

Rock, gravel, and other appurtenances used to keep trenches free from water or used to add support to installed piping is considered incidental to construction and all costs shall be the responsibility of the Contractor.

- E. Survey Control Range Boxes: Protect existing survey control monuments from damage. Contractor will be responsible for replacement or repair of any monument damaged or destroyed. Replacement of monuments must be performed by a qualified land surveyor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, manufacturers specified.

2.2 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe and Fittings, 15-inches and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals. Maximum pipe length 20-feet.
- B. PVC Pressure Pipe: As specified in Division 31 Section "Onsite Wastewater Treatment System".

2.3 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, strong back, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 - 1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2.4 CLEANOUTS

- A. Gray-Iron Cleanouts: For use in vehicular areas. ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
 - 1. Manufacturers:
 - a. Josam Company.
 - b. MIFAB Manufacturing Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Watts Industries, Inc.
 - e. Watts Industries, Inc.; Enpoco, Inc. Div.
 - f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
 - 2. Top-Loading Classification: Heavy duty.

3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.
- B. PVC Cleanouts: For use in pedestrian or non-vehicular area. PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
1. Manufacturers:
 - a. Canplas Inc.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Light Commercial Specialty Plumbing Products; Zurn Plumbing Products Group.

2.5 TRACER WIRE

- A. As indicated on the drawings, install tracer wire on all new PVC piping and service laterals.
1. Wire: Minimum #12 AWG solid copper wire with 0.03 inch blue colored PE insulation.
 2. PVC tape, 2-inch wide.
 3. Locator wire test sites: Two terminal, switchable lid manufactured of non-corrosive, injection molded resin. Base material shall be high-grade ABS rigid plastic in accordance with ASTM D1788, Type 1. Use SnakePit Access Points by Copperhead Industries, or approved equal. Provide stamped aluminum label secured to inside of lid indicating utility that test site is connected to.

2.6 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
1. Diameter: 48-inches minimum, unless otherwise indicated.
 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 3. Base Section: 8-inch minimum thickness for floor slab and minimum thickness for walls and base riser section, being 1/12 of internal diameter and having separate base slab or base section with integral floor. Base to have integral wall section one to three (1-3) feet high.
 4. Riser Sections: minimum wall thickness of 1/12 of internal diameter (IE: 1/12 – 48" \varnothing = 4" minimum thickness), and of length to provide depth indicated.
 5. Top Section: Eccentric-cone type, unless flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 6. Manhole Joint Sealant: All joints in the manhole barrel, cone and/or flat top sections including the joint between the cast-in-place base slab and the bottom barrel section shall be sealed with a preformed, flexible plastic gasket conforming to the following requirements.
 - a. The flexible plastic gasket shall be in conformance with Federal Specification SS-S 00210, "Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints".

- b. The plastic sealing compound shall be packaged in extruded preformed rope-like shape of proper size to completely fill the joint when fully compressed. The material shall be protected by a suitable, removable, two-piece wrapper so that one wrapper may be removed as the compound is applied to the joint surface without disturbing the other wrapper, which remains attached to the compound for protection. The sealing compound shall be impermeable to water, have high immediate bonding strength to the primed concrete surface, and shall maintain permanent plasticity, resistance to water, acids, and alkalis.
 - c. All surfaces of the tongue and groove joint of the manhole barrel shall be primed with an approved priming compound prior to the installation of the sealing compound. The application of the priming compound and the sealing compound shall be accomplished in strict conformance with the manufacturer's instructions, as to the method of application, quantity of material, the grade of the materials, and the application temperatures.
 - d. All lifting holes shall be sealed with the plastic sealing compound.
 - e. All joints shall be sealed with non-shrink grout both inside and outside.
 - f. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
7. Manhole Steps: All manhole steps shall be similar and equal to those specified below and shall be installed in a straight line vertically. Manhole steps shall be cast into the wall at the same time the barrel section is cast. Except for unusual circumstances, steps which are inserted or grouted in the wall after the wall has been cast will not be accepted. Steps shall be installed with a nominal spacing of 15-inches and a minimum of 5.5-inches from face of manhole.
- a. Polypropylene Reinforced Plastic: ASTM Specifications
 - 1) ASTM C-478
 - 2) ASTM A-615 Grade 60 (steel rod)
 - 3) ASTM 2146 69, Type II Grade 16906 (polypropylene)
 - 4) Provide a minimum 500 lb carrying load 6-inches from face of manhole.
 - b. Aluminum, Federal specification QQ-A-200/8, or ALMAG35. Two non-skid grooves in surface of step and capable of carrying load of 1000 lbs. 6" from face of manhole.
8. Grade Rings: Reinforced-concrete rings, 3- to 9-inch total thickness, to match diameter of manhole frame and cover.
9. Protective Coating: Plant-applied, epoxy-polyamide paint; minimum thickness applied to interior surfaces of existing manholes to be rehabilitated as indicated on the drawings. Interior surfaces include all bench, invert, and manhole walls.
10. Manhole Frames and Covers: Ferrous; 24-inch ID by 7-inch to 9-inch riser with 4-inch minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER." Ring and cover combined weight greater than 400 lbs., machined to fit securely. Non-rocking cover.
- a. Material: ASTM A 48 iron, unless otherwise indicated.
- B. Cast-in-Place-Concrete Manhole Bases: Construct of reinforced-concrete bottom; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), structural loading; of depth, shape, dimensions, and appurtenances indicated.
- 1. Ballast: Increase thickness of concrete as required to prevent flotation.

2. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.

2.7 CONCRETE

- A. General: Contractor is responsible for replacement of sidewalks as required to perform the work. Removal and replacement of the above items will be included under piping bid item. All workmanship and products furnished shall be per Division 32, section "Concrete Paving."
- B. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and as specified in Division 03 Section "Miscellaneous Cast-In-Place Concrete".
- C. Manhole Channels and Benches: Factory or field formed from concrete. Include channels and benches in manholes as indicated on the drawings.
 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: 2 percent minimum through manhole or as shown on drawings.
 2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 8 percent.
- D. Ballast and Pipe Supports:
 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.
- E. Job Mixed Concrete will not be allowed.
- F. Ready Mixed Concrete: Proportioned, mixed, and transported in accordance with ASTM C94. Any concrete not plastic and workable when it reaches project shall be rejected.
- G. Expansion Joint Material: AASHTO M173.
- H. Curing Materials:
 1. Burlap Cloth from Jute or Kenaf: AASHTO M182.
 2. White Liquid Membrane: AASHTO M148, 1 gal/150 SF.
 3. Sheet Materials: AASHTO M171, 4 mil.

2.8 MORTAR

- A. The mortar shall consist of one part cement, 0.15 part lime, and three parts sand, measured by volume. The cement, lime and sand shall be first mixed dry to a uniform color in a suitable box or batch mixer and then mixed with water thoroughly; the water being added gradually until the required consistency is obtained. Mortar shall be mixed in batches of such size as will be used immediately. Retempered mortar, or any mortar which has been mixed for more than one-half hour shall not be used. When mortar is molded into briquettes one square-inch in cross-section,

it shall attain an ultimate tensile stress of 125 pounds per square-inch after one day in air and six days in water, and 175 pounds per square-inch after one day in air and twenty-seven days in water.

2.9 MANHOLE PROTECTIVE COATINGS

- A. Coatings for Manhole Rehabilitation: Epoxy resin coatings commonly used in applications related to protective coatings for existing concrete surfaces. Use Sikagard 62, or approved equal, and apply as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Trenching and Backfilling" In addition meet the following requirements:
- B. Exploratory Excavation: It shall be the Contractor's responsibility to excavate and locate all existing utilities which may affect construction of the sewer facilities. All exploratory excavations shall occur far enough in advance to permit any necessary relocation to be made with minimum delay. All costs incurred by the Contractor in making exploratory excavations shall be considered to be included in the unit price bid for constructing each section of sewer line or the associate structures.

3.2 UNSTABLE TRENCH BOTTOM

Where trench does not have sufficient strength to support pipe and bedding, or stream crossings are encountered, refer to Division 31 Section "Trenching and Backfilling".

3.3 GROUNDWATER

- A. Water seeping from trench banks or flowing in trench bottom, but not flowing in trench bottom: Install gravel as specified in Division 31 Section "Trenching and Backfilling".

3.4 PIPING APPLICATIONS

- A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
 - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
 - a. Shielded flexible couplings for same or minor difference OD pipes.
 - b. Shielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Couplings shall be encased in minimum 4-inch concrete all around coupling and shall extend a minimum 18-inches beyond end of coupling.

3.5 PIPING INSTALLATION

- A. Remove and dispose of existing sanitary sewer pipe where shown on drawings. Service is to be temporarily suspended during installation of the new pipeline. Pumping between manholes is not anticipated.
- B. Construct pipe accurately to line and grade shown on drawings. Remove and replace pipe not conforming to line and grade at Contractor's expense.
- C. Install per manufacturer's recommendations by placing pipe continuously upgrade. Bell ends to face upgrade. Prior to making joints, clean and dry all surfaces. Use lubricants in conformance with manufacturer's recommendations for insertion of pipe in joint. Set pipe in position and check line and grade. Keep dirt from entering all exposed pipe ends. Joints shall be watertight.
- D. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected, or where new services are connected to existing building systems. Reducing size of piping in direction of flow is prohibited.
- F. Install gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at a slope shown on plans.
 - 2. Install piping with 36-inch minimum cover unless otherwise indicated.
 - 3. Install piping below frost line, or provide insulation materials where indicated.
 - 4. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
- G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.
- H. Wyes and Risers for Service Connections: Angle upward so 1/8 bend connected to fitting will make service line invert equal to inside crown of sewer main.
- I. Keep trenches free from water during pipe laying and jointing. Dewatering of trench, including rock or gravel underdrain, considered as incidental to construction and all costs shall be included in contract prices. When pipe laying is not in progress, close open ends of pipe by watertight plug, or other means approved by the Contracting Officer.

Dewatering shall be accomplished by the use of well points, sump pumps, rock or gravel drains placed below subgrade foundations or subsurface pipe drains. All water shall be disposed of in a suitable manner without being a menace to public health or causing public inconvenience. No water shall be drained into other work being completed or under construction.

The dewatering operation shall continue until such time as it is safe to allow the water table to rise in the excavations. Pipe trenches shall contain enough backfill to prevent pipe flotation.

Water shall not be allowed to rise until the concrete has set a minimum of twenty-four (24) hours, and the forms have been removed. Water shall not be allowed to rise unequally against unsupported structural walls.

Contractor is responsible for obtaining dewatering permit through the State as required.

3.6 TRACER WIRE INSTALLATION

- A. Tracer wire shall be installed the full length of buried pipe and shall terminate at test stations to be located as directed by the Contracting Officer.
 - 1. Attach tracer wire to pipe with 2-inch-wide PVC tape around circumference of pipe diameter.
 - 2. Splice wire in accordance with the manufacturer's recommendations.
 - 3. Leave 3 feet of slack wire in test site.
 - 4. In the presence of the Contracting Officer, verify continuity of the tracer wire.
 - 5. Locate test sites a minimum of 500 feet from each other and in a location easily accessible and outside of vehicular ways.

3.7 PIPING INSULATION

- A. Install insulation over and around sanitary piping where indicated on the drawings or where the depth of cover is less than 72 inches.
 - 1. Where sanitary piping is installed with less than 72 inches of cover, install minimum one inch of insulation material for every 12-inches of cover that cannot be provided.
 - 2. Existing sanitary piping shall be insulated where it crosses Big Horn Creek as indicated on the drawings. Encase existing pipe on all side with insulation material as detailed on the plans.

3.8 UTILITIES ENCOUNTERED

- A. Protection of all existing gas, water, sewer services, culverts, drains, cable, telephone lines, and electric lines encountered during construction is the Contractor's responsibility, and if utilities are disturbed, they shall be maintained and/or restored to original condition at no additional cost to the Government. Backfill around utilities shall be adequately compacted to assure permanent stability.

3.9 WATER LINE CROSSING

- A. Normal Conditions: Whenever possible, lay sanitary sewer under water main to provide vertical separation of at least 18" between invert of water main and crown of sewer.
- B. Unusual Conditions: If above separation cannot be met, use the following:
 - 1. Sewer passing over or less than 18" under water main:
 - a. One continuous length of watertight pipe 18-feet to 20-feet long centered on water main. Joints between different pipes encased in concrete 6-inches thick and extending 6-inches either side of joint; or
 - b. Sewer pipe encased in 6-inches of concrete around pipe, and extend 10-foot either side of water main.

2. Water mains passing under sewers: If vertical separation less than 18-inches, provide structural support for sewer.

3.10 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
 1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
 2. Join dissimilar pipe materials with nonpressure-type, flexible, shielded couplings encased in concrete.

3.11 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Manhole: Construct in accordance with drawings for cast-in-place manholes. Extend concrete manhole base at least 10" below pipe barrel. Slope floor of manhole from centerline of pipe to maximum of 2" above top of pipe at face of manhole. Shape invert exactly to lower half of pipe. Construct side branches with as large radius of curvature as possible to connect to main invert. Inverts shall be smooth and clean with no obstructions, allowing insertion of an expandable plug in pipe. Form concrete ring monolithically with manhole base, minimum of 3" above top of pipe. Terminate future extension of pipe with bell of pipe as close as practical to manhole base. Install watertight plug in bell. Do not set precast manhole sections on manhole base for minimum of 2 days after base placement. Thoroughly clean top of formed concrete base ring in manhole. Place complete and continuous roll of joint sealant on base ring in sufficient quantity so there will be no spaces allowing infiltration. Join each succeeding manhole section in similar manner. Trim away all excess material and repair all lifting holes. Turn eccentric cone and steps away from roadway ditch.
- C. Manhole Ring and Cover: Install at grade of finished surface. Where surface will be completed after manhole construction, set top of cone so maximum of two courses of grade rings will adjust ring and cover to final grade. Grout as required.
- D. Install precast concrete manhole sections with sealants according to ASTM C 891 SS-S 00210.

3.12 CONCRETE PLACEMENT:

- A. As specified in Division 03 Section "Miscellaneous Cast-In-Place Concrete".
- B. Place cast-in-place concrete according to ACI 318/318R.
- C. Subgrade/Base Course: Check for soft spots by proof-rolling or other means prior to setting forms. Remove soft yielding material and replace. Compact to 95% AASHTO T180. Wet to optimum moisture to 6" deep, not more than 12 hours prior to placement so subgrade will not absorb moisture from concrete.

- D. Placement: Place to required depth and width Place concrete as uniformly as possible in order to minimize amount of additional spreading. Place and consolidate with suitable tools to avoid formations of voids, honeycomb, or pockets. Well vibrated and tamped against forms.
- E. Retempering: Do not retemper concrete or mortar which has partially hardened by remixing with or without additional cement, aggregate, or water. Provide concrete in such quantity as is required for immediate use.
- F. Curing: Protect against loss of moisture, rapid temperature change, rain, and flowing water, for not less than two days from placement of concrete. Immediately after finishing, cover concrete surface with curing medium which is applicable to local conditions as approved by the Contracting Officer. Protect exposed edge of concrete slabs exposed by removing forms immediately to provide these surfaces with continuous curing treatment.

3.13 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use gray-iron heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
 - 2. Use PVC cleanouts as indicated or in non-traffic areas.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18-inches by 18-inches by 8-inches deep. Set with tops 1-inch above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement with tops ¼-inch below pavement surface.

3.14 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 15 Section.
- B. Make connections to existing piping.
 - 1. Use commercially manufactured saddle wye tap fittings for piping branch connections. Stainless steel straps shall be used full diameter to hold saddle. Existing pipe shall be core drilled full diameter of branch.
 - 2. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Existing sanitary sewer service connection: Includes reconnection of existing services to new service or mainline piping. Place true to line and grade in accordance with drawings, in shortest direct route. Each transition connection shall be observed by the Contracting Officer prior to backfilling. Contractor is responsible for determining if existing services are active and locating them prior to trenching. Non-active service shall not be reconnected to the new sanitary sewer line.

3.15 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 - 1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
 - 3. Fill abandoned pipe if pipe is 15-inches or longer with sand or flowfill. Submit method utilized for the Contracting Officer's review and approval prior to implementing.
- B. Backfill to grade according to Division 31 Section "Trenching and Backfilling".

3.16 REHABILITATION OF EXISTING MANHOLES

- A. All manholes that have less than 0.20' of drop through the manhole shall receive a protective coating as specified above.
- B. Where indicated on the drawings, rehabilitate existing manholes to the satisfaction of the Contracting Officer and as indicated below.
 - 1. Remove all sediment, sludge, and deleterious substances from inside of manhole.
 - 2. Pressure wash manhole barrel and base completely to remove build up on manhole walls.
 - 3. Remove existing steps and replace with new steps as specified above.
 - 4. Form and construct manhole bench and trough in accordance with the details on the drawings.
 - 5. Apply manhole protective coating as recommended by the manufacturer.

3.17 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Trenching and Backfilling". Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
 - 1. Use detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.18 TRAFFIC REGULATION

- A. Conformance: "Manual of Uniform Traffic Control Devices," U.S. Department of Transportation, or applicable statutory requirements of authority having jurisdiction.
 - 1. Unless otherwise authorized, keep at least one lane of traffic open at all times.
 - 2. When work is not in progress, keep all traffic lanes open.
- B. Keep traffic areas free of excavated material, construction equipment, pipe, and other materials and equipment.

- C. Warning Signs and Lights: Protect all roadways by effective barricades on which are placed acceptable warning signs. Provide suitable barricades and warning signs for open trenches, other excavations, and obstructions. Illuminate by means of warning lights all barricades and obstructions from sunset to sunrise.

Flagmen where required are to provide for public safety and regulation of traffic.

- D. Roadway Usage Between Operations: At all times when work is not actually in progress, Contractor shall make open, passable, and maintain to traffic such portions thereof as may be agreed upon between Contractor and the Contracting Officer.

3.19 FIELD QUALITY CONTROL

- A. Notify Contracting Officer at least 24 hours in advance of pipe being laid in any trench. Cover no pipes until observed by the Contracting Officer. Notify the Contracting Officer at least 48 hours before pipe is to be tested.

Where testing by infiltration or exfiltration is not practical due to service line connections, taped televising of the entire pipe line installed will be required. Payment for televising shall be included within the unit price bid for sanitary sewer.

- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24-inches of backfill is in place, and again at completion of Project.
 - 1. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 2. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 3. Reinspect and repeat procedure until results are satisfactory.
- C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction, but meet the following as a minimum:
 - a. General: Conduct infiltration or exfiltration test for each section between manholes. Test first section of pipe laid to verify if watertight. Testing may be required during course of work where infiltration appears to be greater than maximum allowable, or quality of work is questionable. No sewer line will be accepted where watertightness tests show leakage exceeding 200 gallons per-inch diameter per mile per day. Flush and clean sewer line prior to testing, wetting pipe, and cleaning out debris. Plug all pipe outlets to resist test pressure.

- b. Infiltration Test: In high ground water table installation only. Plug upper manhole to determine leakage in section of line between consecutive manholes. Record quantity of water collected in time period to calculate infiltration rate.
- c. Exfiltration Test by Water: Plug line just above upper manhole, and pipe entrance in lower manhole. Fill pipe from upper manhole to no less than 4' depth at upper manhole. Make mark at water surface level in manhole and allow to stand for 4 hours to allow absorption in walls of manhole and pipes. Add water to bring water surface back to mark. Record drop in elevation of water surface in one hour; convert to exfiltration rate.
- d. Exfiltration Test by Air: Test each section of pipe between consecutive manholes to determine test duration for section by computation from Air Test Tables. Pressure-holding time is based on an average holding pressure of 3 psi gauge or a drop from 3.5 psi to 2.5 psi gauge. Add air until internal air pressure of sewer line is raised to approximately 4.0 psi gauge. After internal pressure of approximately 4.0 psi is obtained, allow time for air pressure to stabilize. Pressure will normally show some drop until temperature of air in test section stabilizes. When pressure has stabilized and is at or above starting test pressure of 3.5 psi gauge, commence test. Before starting test, pressure may be allowed to drop to 3.5 psi. Record drop in pressure for test period. If pressure has dropped more than 1.0 psi gauge during test line has failed. Test may be discontinued when prescribed test time has been completed even though 1.0 psi drop has not occurred. ASTM C828 "Low Pressure Air Test for Sanitary Sewers".

REQUIRED FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE

1 Pipe Diameter (in.)	2 Minimum Time (min: Sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specified Minimum for Length Shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

3. Schedule tests and inspections with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - a. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
 - b. Close openings in system and fill with water.
 - c. Purge air and refill with water.
 - d. Disconnect water supply.
 - e. Test and inspect joints for leaks.

- f. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 psig.
- D. Leaks and loss in test pressure constitute defects that must be repaired.
- E. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
- F. The last page of this specification section "Air Test Data Sheet" is to be utilized by the Contractor to record his test results. Other forms can be utilized if approval of the Contracting Officer is obtained prior to conducting tests. Upon request, an electronic copy of "Air Test Data Sheet" can be provided to the Contractor from the Contracting Officer.

3.20 LOCATION OF EXISTING SERVICES

- A. The Contractor is responsible for locating existing services. The Government has existing video tapes available for Contractors viewing although these tapes in no way release the Contractor from responsibility for location.

3.21 CLEANUP AND RESTORATION

- A. Restore all pavements, curbs, gutters, utilities, fences, culverts, irrigation ditches, yards, lawns, and other structures or surfaces to condition equal to or better than before work began, and to satisfaction of the Contracting Officer. Deposit all waste material off-site. Complete topsoil and reseeding of site, is required.
- B. General cleanup of the area shall be performed on a daily basis to the satisfaction of the Contracting Officer. Proper safety provisions, including ropes, fence, barricades, construction signs, and warning signs, shall be maintained until completion of work.

END OF SECTION 333100

AIR TEST DATA SHEET

Owner (Name of City, District, etc) _____ Test No. _____

Identification of Pipe Installation (Job Name, Location, Contract No. etc) _____

Field Test Data: (To be filled in by the Resident)

Date: _____ Specified Maximum Pressure Drop: _____ psig

Identification of Pipe Material Installed: _____

Pipe Under Test				Specification Time	Field Test Operations Data					
Upstream Manhole Station No.	Downstream Manhole Station No.	Dia. D (in.)	Length L (ft.)	Refer to Table (min:sec)	Pressure Initially Raised to (psig)	Time Allowed For Pressure To Stabilize (min)	Start Test Press. (psig)	Stop Test Press. (psig)	Elapsed Time (min:sec)	Pass or Fail (P or F)

Residents Name and Title: _____

Signature of Resident: _____

If a section fails, the following items shall be completed:

Identify section(s) that failed: _____

Leak (was) (was not) located. Method used: _____

Description of leakage found: _____

Description of corrective action taken: _____

For test results after repair refer to Test No. _____ Resident: _____

SECTION 333400 - ONSITE WASTEWATER TREATMENT SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Contractor shall furnish all labor, materials, equipment and incidentals required to provide onsite wastewater treatment equipment, as specified herein and shown in the Drawings.

1.2 REFERENCES

- A. Hydraulic Institute Standards
- B. National Electric Code Standards
- C. National Fire Protection Association
- D. NFPA 820 - "Standard for Fire Protection in Wastewater Treatment and Collection Facilities"
- E. Larimer County Department of Health and Environment On-Site Wastewater Treatment System Regulations (July 01, 2021)
- F. Colorado Department of Public Health and Environment, Regulation No. 43 – On-Site Wastewater Treatment System Regulation, 5 CCR 1002-43.

1.3 RELATED DOCUMENTS

- A. Division 31 Sections "Site Clearing" and "Earth Moving".

1.4 SUBMITTALS

- A. Product Data: Pump curves, equipment schedules and data, material descriptions, construction details, dimensions of individual components and profiles.
- B. Shop Drawings: Show location and details of operational hardware and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, elevations, sections and other required installation and operational clearances, and details of anchorage and attachment and bracing.
- C. Wiring Diagrams: Power and control wiring. Differentiate between Manufacturer-installed and field-installed wiring and between components provided by Manufacturer and those provided by others.
- D. Product Certificates: Signed by Manufacturers certifying that products furnished comply with requirements.

- E. Quality Certifications: Submit ISO 9001, UL or similar certifications, that may be held by the Manufacturer.
- F. Qualification Data: Manufacturers/Suppliers shall provide a list of ten (10) similar projects completed in the U.S. within the past 5 years. Provided project information shall include project names and addresses, names, addresses and telephone numbers of owners, and other pertinent information such as design flow and influent and effluent parameters.
- G. Factory Testing: Equipment factory test results shall be submitted to the Contracting Officer.
- H. Field Test and Startup Reports: Field testing and startup monitoring reports shall be submitted to the Contracting Officer. Indicate and interpret test results for compliance with performance requirements.
- I. Test Reports: Submit laboratory gradation tests for soils and aggregate materials.

1.5 OPERATIONS & MAINTENANCE MANUALS

- A. Operations and maintenance manuals shall be prepared as described in Division 01 of these specifications.

1.6 SUMMARY

- A. The onsite wastewater treatment system shall consist of, but not be limited to:
 1. Abandonment of the existing onsite wastewater treatment system serving the existing facilities related to the project.
 2. 1,250-gallon nominal capacity three compartment septic tank.
 3. Mounded soil treatment area with a minimum mound top area of 465 square feet and a minimum mound basal area of 845 square feet.
 4. Effluent distribution piping.
 5. Effluent dosing pump and controls.

1.7 PROJECT QUALITY ASSURANCE AND REQUIREMENTS

- A. Perform Work in accordance with applicable State, County, and jurisdictional authority's standards, specifications, rules, requirements, regulations, and industry standards.
 1. Work is to meet Larimer County Department of Health and Environment, On-Site Wastewater Treatment Systems Regulations.
- B. Manufacturer's Directions: Manufacturer's directions and detailed drawings shall be followed in all cases where the Manufacturers of articles used in the work covered by this specification furnish said directions and/or detailed drawings covering points not shown in the drawings and specifications.
- C. Ordinances, Codes and Regulations: All local, municipal and state laws, and all rules and regulations governing or relating to any portion of the work covered by this specification are hereby incorporated into and made a part of these specifications, and their provisions shall be

carried out by the Contractor. Anything contained in these specifications or on the drawings shall not be construed to conflict with any of the above laws, rules or regulations and requirements of the same.

- D. Explanation of Drawings: Drawings are generally diagrammatic and indicative of the work to be installed. Due to the scale of the drawings, it is not possible to indicate all offsets, fittings, sleeves, etc., which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of his work and shall plan his work accordingly, furnishing such fittings, etc., as may be required to meet such conditions. The work shall be installed in such a manner as to avoid conflicts with other work on this site. The Contractor shall not willfully install the wastewater treatment system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in the design. Such obstructions or differences shall be brought to the attention of the CO. In the event this notification is not performed, the Contractor shall assume full responsibility for any revisions necessary.

PART 2 - PRODUCTS

2.1 ONSITE WASTEWATER TREATMENT SYSTEM

- A. Onsite wastewater treatment system shall include a 1,250-gallon nominal capacity three compartment septic tank.
1. Tank shall be constructed of precast concrete and constructed monolithically, meeting ASTM C-1227 for water and wastewater structures. Tank shall be designed or otherwise anchored to prevent floatation of the tank.
 2. The joint between the septic tank and the cover shall be sealed with butyl rubber sealant, Ram-nek, or approved equal, and as specified in section 333100.
 3. The first two chambers combined shall have a minimum capacity of 930 gallons and the third chamber shall have a minimum capacity of 254 gallons.
 4. Chambers shall be separated by interior precast concrete baffle walls. The baffle wall between the second and third chambers shall be sealed watertight.
 5. Septic tank shall be Front Range Precast Concrete, Inc., part number PCA-000-267, or approved equal.
- B. Septic tank inlet and outlet connections shall be equipped with Cast-a-Seal Gaskets. Inlet connection shall be sized for 6" SDR 35 PVC pipe. Outlet connection shall be sized for 1.5" Class 200 PVC pipe.
- C. Each septic tank chamber shall be equipped with a 24" access hole, riser, and cover set at grade as shown on the drawings.
1. Risers shall be 24" interior diameter precast concrete riser sections. Access riser section for the third chamber shall be modified riser equipped with exterior splice box for pump controls and power cables as well as float tree bracket.
 2. Covers shall be standard 24" diameter cast iron manhole ring and cover, as specified in section 333100.

- D. Septic tank secondary chamber shall be equipped with an effluent filter. Effluent filter shall be Orenco Water PSC-Series Biotube effluent filter, or approved equal, equipped with a PVC handle extension to bring the handle to 6” below grade in the septic tank access riser.

2.2 PIPING

A. Septic Tank Influent Piping:

- 1. Polyvinyl Chloride (PVC): 4”-15”, ASTM D3034, Type PSM, SDR35; Push on joints and molded rubber gaskets. Maximum pipe length 20’.

B. Septic Tank Effluent and Soil Treatment Area Distribution Piping:

- 1. Polyvinyl Chloride (PVC): 1.25”-12”, ASTM D2241, Pressure Conduit, Class 200 (SDR21); Push on joints and elastomeric gaskets. Maximum pipe length 20’.

2.3 WASTEWATER EFFLUENT PRESSURE PUMP

A. Manufacturers:

- 1. Goulds Water Technology, Model PE31
- 2. Or approved equal.

B. Product Requirements

- 1. Provide one duty pump installed in the effluent dosing chamber and one spare pump to be stored on site as a redundant back up pump.
- 2. Shall be a sump pump design with cast iron body, thermoplastic impeller and cover.
- 3. Pump must be resistant to corrosion and clogging from septic tank effluent.
- 4. Mechanical seal shall be carbon ceramic, BUNA, and stainless steel.
- 5. Motor shall be 115 V., 1 ph., 60 Hz equipped with built-in thermal overload protection with automatic reset and a high strength carbon steel shaft.
- 6. Solids handling: ½” maximum sphere
- 7. Discharge: 1 ½” NPT
- 8. Temperature Rating: 104°F maximum, continuous when fully submerged.
- 9. Design Duty Point Flow Rate: 35 gpm
- 10. Design Total Dynamic Head: 13.5 ft
- 11. Motor HP: 1/3
- 12. Warranty: 2 years

- C. Three floats shall be included for “on”, “off” and “high level”. Levels shall be as indicated on drawings. Floats shall be mercury free and rated for wastewater use. Floats shall be CentriPro A2N Series SJE SignalMaster Control Switches, or approved equal.

2.4 SOIL TREATMENT AREA

- A. Construct Soil Treatment Area (STA) as indicated on drawings and in accordance with Larimer County Department of Health and Environment On-Site Wastewater Treatment System Regulations.

B. Flushing Valve

1. Schedule 40 PVC True Union Ball Valve
2. Schedule 40 PVC Threaded Coupling and Plug
3. 10" Diameter HDPE valve box with cover. Black box with green lid, marked "Sewer". Provide NDS Pro-Spec Series, or approved equal.

C. Observation Ports

1. SDR 35 PVC with threaded cap. See information provided in this specification for SDR 35 PVC pipe.

D. Drainage Rock

1. 1"-2" Crushed Rock - AASHTO Class 3 gradation:

Nominal Size	Percent Passing by Weight
2 1/2"	100
2"	90-100
1 1/2"	35-70
1"	0-15
1/2"	0-5

E. Sand Media

1. "Preferred" Sand Media Requirements shall be used, if reasonably available in the project area, and shall be as follows:
 - a. Effective size: 0.25 – 0.60 mm
 - b. Uniformity coefficient: less than or equal to 4.0
 - c. Percent fines passing #200 sieve: less than or equal to 3.0
2. "Secondary Sand Media Requirements shall be used, only if sand media meeting the above "preferred" sand media requirements above is not reasonably available in the project area, and shall be as follows:
 - a. Effective size: 0.15 – 0.60 mm
 - b. Uniformity coefficient: less than or equal to 7.0
 - c. Percent fines passing #200 sieve: less than or equal to 3.0
3. A gradation of the proposed sand media shall be submitted to the Contracting Officer. The gradation report shall be certified and dated no more than one month prior to the installation date. A gradation of the actual material proposed to be placed in the STA mound is recommended.

F. Non-Woven geotextile fabric

1. Manufacturers: US Fabrics Inc. DuPont SF 20, or approved equal.
2. 60 lbs tensile strength.
3. Water flow rate of 157 g/min/ft² per ASTM D4491.

PART 3 - EXECUTION

3.1 OBSERVATION OF SITE CONDITIONS

- A. Examination of existing conditions before starting work is required.
- B. Compliance monitoring is required during construction of the OWTS. There is a potential impact to archeologically sensitive areas in the vicinity of the proposed OWTS. Refer to Division 1 requirements.
- C. All scaled dimensions are approximate. The Contractor shall check and verify all dimensions prior to proceeding with this work. If significant discrepancies are discovered that would affect the progress of the work, the Contractor shall notify the Contracting Officer before proceeding.
- D. The Contractor shall take whatever precautions are necessary to protect these underground lines from damage, and, in the event damages do occur, all damage shall be repaired by the Contractor. All costs of such work shall be at the Contractor's own expense.
- E. Protection of property: The Contractor shall be responsible for the preservation and protection of all site conditions to remain as part of the finished project. In the event damage does occur, all damage shall be completely repaired to its original condition or better. All costs of such work shall be at the Contractor's own expense.
- F. The Contractor shall carefully check all grades and existing site equipment and conditions to satisfy himself that he may safely proceed before starting work on the wastewater treatment system.

3.2 PREPARATION

- A. Physical layout: Prior to installation, the Contractor shall stake out the locations of all tanks, vessels, equipment pads, the routing of all pipe lines, including electrical conduit runs, and the locations of the control panels. This layout shall be approved by the Contracting Officer prior to proceeding with installation.
- B. Manufacturer recommendations and requirements shall be followed by contractor for installation of equipment and tank components.

3.3 ABANDONMENT OF EXISTING ONSITE WASTERWATER TREATMENT SYSTEM

- A. Existing onsite wastewater treatment system shall be abandoned in accordance with these specifications and Larimer County Department of Health and Environment On-Site Wastewater Treatment Systems Regulations. Existing sand filter, soil treatment area, and sludge pond shall be abandoned in place. Existing septic tank and dosing chamber shall be abandoned as per the following procedures:
 - 1. Existing septic tank and dosing chamber shall be abandoned in place by following these requirements:
 - a. The septic tank and dosing chamber shall be pumped completely dry.

- b. The bottom of the septic tank and dosing chamber shall be broken to prevent floatation and filling with water.
- c. The top of the septic tank and dosing chamber shall be collapsed and the sides may be broken into the void.
- d. The remaining void shall be filled with general fill material as defined in Division 31 section "Earth Moving."
- e. The backfilled excavation shall be compacted to 90% of the standard proctor and graded to match existing grade with suitable soil cover and revegetated.

3.4 FACTORY TESTING

- A. The pumps and other moving parts of the packaged treatment system shall be factory tested by the Manufacturer before shipping to site. Test methods and results shall be provided to the Contracting Officer.

3.5 TANK LEAK TIGHTNESS TESTING

- A. The first two chambers of the septic tank shall be considered a single containment structure and shall be tested separately from the third chamber of the septic tank.
- B. The Contractor shall commence tightness testing within five business days of notification that the structure is ready for testing.
- C. Testing shall be performed using the hydrostatic tightness test, which consists of two parts. Part 2 may be waived if approved by the Contracting Officer.
 - 1. Part 1 shall be a qualitative criterion.
 - 2. Part 2 shall be a quantitative criterion expressed as a maximum allowable volume loss of 0.05 percent per 24-hour period.
- D. No backfill may be placed against the walls or on the wall footings of the containment structures to be tested, unless otherwise specified.
- E. The initial filling of a new containment structure shall not exceed four feet per hour. Filling shall be continued until the water surface is at the design maximum liquid level, or either one inch below any fixed overflow level in covered containment structures or four inches in open containment structures, whichever is lower.
- F. Water for the initial filling shall be provided by the Contractor. Use potable water unless otherwise specified.
- G. Part 1 – Qualitative criteria
 - 1. If any water is observed on the containment structure exterior wall surfaces where moisture can be picked up on a dry hand, the containment structure shall be considered to have failed Part 1 of the hydrostatic test.
 - 2. Wet areas on top of the wall footing shall not be cause to fail Part 1 unless the water can be observed to be flowing.

3. Although Part 2 of the test may begin prior to completion of repairs for Part 1, all defects causing the failure of Part 1 shall be repaired before acceptance of the containment structure.
4. The standard repair procedure for areas failing Part 1 is to inject chemical grout into the affected area. Consult with the Precast Tank Engineer before commencing any such repairs.

H. Part 2 – Quantitative criteria

1. Part 2 of the hydrostatic tightness test shall not be scheduled for a period when the forecast is for a difference of more than 35° F between the ambient temperature readings at the times of the initial and final level measurements of the water surface. The test shall also not be scheduled when the weather forecast indicates the water surface could freeze before the test is completed.
2. The vertical distance to the water surface shall be measured to within 1/16 inch from a fixed point on the containment structure above the water surface. The initial measurement shall not be taken until at least 24 hours after the tank is completely filled. Measurements shall be recorded at 24-hour intervals.
3. The test period shall be the theoretical time required to lower the water surface 3/8 inch, assuming a loss of water at the maximum allowable rate. However, the test period shall not be longer than five days.
4. In uncovered containment structures, evaporation and precipitation shall be measured.
5. At the end of the test period, the water surface shall be recorded to within 1/16 inch at the location of the original measurements. The water temperature and precipitation measurements shall be recorded.
6. The change in water volume in the containment structure shall be calculated and corrected, if necessary, for evaporation, precipitation, and temperature. If the loss exceeds the required criterion, the containment shall be considered to have failed Part 2 of the test.

I. Retesting

1. A restart of the test shall be required when test measurements become unreliable due to unusual precipitation or other external factors.
2. It shall be permitted to immediately retest a containment structure failing Part 2 of the hydrostatic test when Part 1 is passed. If the containment structure fails the second test or if not immediately retested after the first test failure, the interior of the containment structure shall be observed for probable problem areas by the Tank Supplier. The containment structure shall only be retested after the probable problem areas are repaired.
3. Containment structures shall be retested until they meet the required Part 1 and Part 2 criteria. Repairs shall be made before each retest.

3.6 CONTRACTOR COORDINATION AND INSTALLATION

A. Pump Systems

1. The pump systems shall be installed in accordance with Manufacturer's instructions, applicable specifications, and details in the Drawings.

B. Assembly

1. Routing of pipes shown on the drawings is diagrammatic. The Contractor shall install lines and appurtenances according to the Manufacturer's instructions and actual layout plan on the site shown in the Drawings.
2. The Contractor shall install all materials in accordance with the respective detail in the Drawings. In the absence of a detail pertaining to a specific item, the Contractor shall perform such work in accordance with best standard practices of the industry.

C. Line Clearance

1. All lines shall have a minimum clearance of at least six inches from lines of other trades. Increase separation, if required, as per appropriate codes and governing authorities.

D. Control Panels

1. Control panels shall be installed and wired as per Manufacturer's instructions and as shown in the Drawings.

E. Lightning Protection

1. Control panels shall be equipped by the Contractor with lightning protection by connecting the ground terminal with a secure clamp to a standard five-eighths inch copper clad steel ground rod, driven a minimum of eight feet into the ground.

F. Electrical

1. All electrical work shall conform to all appropriate codes, ordinances and other applicable authorities or regulations, the referenced specifications and as shown in the Drawings.

G. Onsite Wastewater Treatment System

1. The onsite wastewater treatment system equipment must be located, installed and connected as per Manufacturer's recommendations and specifications and in accordance with the Drawings and project specifications.
2. The area of the site shall be rough graded, excavated, subgrade prepared and backfilled and reinforced concrete tanks installed, as shown in the Drawings, for the placement of the packaged wastewater treatment system equipment.
3. The Contractor shall coordinate delivery and offloading of the onsite wastewater treatment system components.
4. Delivery of the equipment shall be coordinated with excavations.
5. The Contractor shall coordinate finished equipment installation and connection inspection, startup, and full-scale operation (accepting wastewater flow from the facility) with the Contracting Officer and Manufacturer/Supplier.
6. Prior to final acceptance of the project, any special tools for removing, disassembling and/or adjusting equipment supplied on this project, keys for any locking panel and any other manufacturer provided items shall be furnished by the Contractor to the Government as specified by Division 01 "Closeout Procedures".

3.7 SOIL TREATMENT AREA MOUND SYSTEM

- A. Excavation, grading, and earthwork associated with the soil treatment area mound system shall be in conformance with Division 31 sections “Earth Moving” and “Trenching and Backfilling.”
- B. Do not use or drive heavy equipment over the soil treatment area to avoid compacting and consolidating the soil below the soil treatment area mound system. Placement and compaction of the sand media, drain rock, and soil cover material should be completed using hand tools or light-duty equipment.

3.8 FIELD INSPECTION, STARTUP, ACCEPTANCE AND TRAINING

- A. The services of the Contractor and Manufacturer’s field service representative shall be provided for inspection, clean water startup, acceptance and training.
- B. Prior to startup, each pump shall be contractor tested to ensure proper function.
- C. After equipment has been tested and startup has been successfully completed, the Manufacturer’s field service representative shall instruct the Government’s personnel in the care, operation and adjustment of the equipment furnished as specified in Section 01 79 00 Demonstration and Training.

3.9 FIELD QUALITY CONTROL

- A. The Contractor shall perform all field quality control.
- B. The Contractor shall furnish all materials and make all adjustments required to cause the system to operate properly.

3.10 TEMPORARY REPAIRS

- A. The Government reserves the right to make temporary repairs if deemed necessary to keep the treatment system in operating condition. The exercise of this right by the Government shall in no way relieve the Contractor of their responsibilities under the terms of the guarantee.

3.11 MAINTENANCE

- A. During the maintenance period following final acceptance as specified in the Contract Documents, or in the absence of a specific provision of this in the Contract Documents, during a 60-day maintenance period following final acceptance, the Contractor shall provide any maintenance required to adjust the system to restore proper operating function, including but not limited to the following: repair any leaks in any of the pipe lines; clean and/or adjust parts as required; troubleshoot and repair any control system malfunctions.

3.12 WARRANTY

- A. Warranty shall be as specified in Division 1 of these specifications.

END OF SECTION 333400

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SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Additional information concerning storm sewer systems may be found on the civil drawings. In case of conflict between the drawings and the information specified herein, the more stringent requirements shall govern.

1.2 REFERENCES

- A. State of Colorado, Department of Transportation (CDOT): State Department of Highways Standard Construction Specifications for Road and Bridge Construction, current edition.
- B. Reference Standards: Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents.

1.3 SUMMARY

- A. This Section includes gravity-flow, storm utility drainage piping outside the building, with the following components:
 - 1. Piping and flared end sections.
 - 2. Cleanouts.
 - 3. Drains and inlets.
- B. Related Sections include the following:
 - 1. Division 01 Section "Archeological and Historic Resource Protection".
 - 2. Division 01 Section "Historic Preservation Treatment Procedures".
 - 3. Division 01 Section "Temporary Erosion and Sedimentation Control" for erosion and sedimentation control measures.
 - 4. Division 03 Section "Miscellaneous Cast-in-Place Concrete" for concrete structures
 - 5. Division 31 Section "Dewatering"
 - 6. Division 31 Section "Trenching and Backfilling" for excavating and backfilling of utilities.
 - 7. Division 31 Section "Earth Moving" for Site Grading.
 - 8. Division 31 Section "Riprap, Boulders and Bedding".
 - 9. Division 32 Section "Concrete Paving" for concrete materials.
- C. Permits and Fees:
 - 1. Obtain and pay for all permits required for the work of this section.

D. Existing Utilities

1. It shall be the Contractor's responsibility to excavate and verify the location (depth, horizontal alignment, etc.) of all existing utilities that may affect construction of the proposed storm utility drainage piping line. All exploratory excavations shall occur far enough in advance to permit any necessary relocation to be made with minimum delay and to verify existing vertical and horizontal location to determine alignment for the proposed storm utility drainage piping line. All costs incurred by the Contractor in making exploratory excavations shall be considered to be included in the unit price bid for construction of each section of storm utility drainage piping line or the associated structures.

- E. All standard details and specifications of the utility agency shall apply as noted on the construction permit and as required by the agency.

1.4 DEFINITIONS

- A. HDPE: High Density Polyethylene Pipe.
- B. PVC: Polyvinyl Chloride Plastic Pipe.
- C. RCP: Reinforced Concrete Pipe.
- D. RCBC: Reinforced Concrete Box culvert.
- E. CMP: Corrugated Metal Pipe.

1.5 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be watertight with gasketed joint.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
 1. Piping, gaskets, and related appurtenances
 2. Flared end section shop drawings.
 3. Cleanouts, inlets and area drains.
- B. Field Quality-Control Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Do not store plastic inlets, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

- C. Handle catch basins and storm water inlets according to manufacturer's written rigging instructions.
- D. Deliver piping in manufacture's original bundles, securely strapped, and with protective blocking as required. Label or tag each bundle with type, size and quantity of material.
- E. Exercise care to prevent damage to materials during loading, transportation and unloading. Do not drop pipe or fittings.

1.8 PROJECT CONDITIONS

- A. Historical Preservation: Except by specific written authorization, protect all existing site improvements deemed to be of historical significance. Disturbance of historical stone paths, walls, and related infrastructure shall be subject to approval by the Contracting Officer and shall be restored as indicated in the Contract Documents. Contractor is responsible for notifying the Contracting Officer a minimum of two (2) weeks prior to disturbance of said historic elements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE AND FITTINGS

- A. Corrugated-Steel Pipe and Fittings: ASTM A 760/A 760M, Type I with fittings of similar form and construction as pipe.
 - 1. Special-Joint Bands: Corrugated steel with O-ring seals.
 - 2. Standard-Joint Bands: Corrugated Steel.
 - 3. Coating: Zinc.

2.3 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe for utility trenches shall be as specified in Division 33 Section "Subdrainage".

2.6 CONCRETE PIPE AND FITTINGS

- A. RCP Sewer Pipe and Fittings: According to the following:
 - 1. ASTM C 76 and ASTM C 506 and ASTM C 507 for circular, arch, and vertical and horizontal elliptical pipe, respectively. Pipe shall be Class V, Wall B, unless otherwise noted.
 - 2. Joints: Water tight joints meeting ASTM C443 Standard Specification for joints in circular concrete sewer and culvert pipe, using rubber gaskets.
 - 3. Flared End Sections: No standard specifications apply to concrete flared end sections. Provide manufactures specifications with shop drawings to Contracting Officer.
 - a. Flared end sections shall be of the same manufacturer as the concrete piping and shall include manufacturer recommended pipe anchorage devices.
 - b. Flared end sections for PVC piping shall be galvanized steel.

2.7 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 - 1. For Concrete Pipes: ASTM C 443 (ASTM C 443m), rubber.

2.11 STORM WATER INLETS

- A. Area Inlets: Type and manufacture as indicated on plans.

2.15 PIPE OUTLETS

- A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides as shown in plans.
- B. Riprap Basins: Broken, irregular size and shape, graded stone according to Mile High Flod District criteria.
- C. Flared End Section (FES): Precast reinforced concrete or galvanized steel with apron and tapered sides.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Site excavation and filling are specified in Division 31 Section “Earth Moving.”
- B. Excavation and backfilling for utilities are specified in Division 31 Section “Trenching and Backfilling.”

3.2 PREPARATION

- A. Piping: Prior to installation, verify that insides of pipe and pipe joints are clean and free of dirt, mud, oil, shavings from cutting, or other deleterious materials.

3.3 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate location and arrangement of underground storm utility drainage piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. General:
 - 1. Use only undamaged material.
 - 2. Lay pipe on firm bedding with full length of barrel fully supported. Maintain straight lines and uniform grades between invert elevations shown. Inside of pipe shall be smooth and clean.
 - 3. Begin all pipe installation at downstream end of pipe run, with lower segment of pipe in contact with specified bedding. Place bell or groove ends facing upstream.
 - 4. Plug ends temporarily during installation, until connections are made to adjoining pipe or to manholes or inlet structures.
 - 5. Trench excavation and placement and compaction of bedding and backfill are specified in Division 31 Section "Trenching and Backfilling."
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Plug all lifting holes in pipe with approved rubber plug or grout.
- D. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.
- E. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at slopes indicated on plan.
 - 2. Install corrugated steel piping according to ASTM A798/A798M.
 - 3. Install PVC sewer pipe according to ASTM D 2321 and ASTM F1668.
 - 4. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe installation Manual."

3.4 INLETS, OUTLETS AND CATCH BASIN INSTALLATION

- A. Set frames and grates to elevations indicated.
 - 1. Cast-in-place or precast concrete in accordance with drawings and applicable agency having jurisdiction standards. Comply with applicable requirements of Division 03 Section "Miscellaneous Cast-in-Place Concrete."

2. Construct inverts of pipe or concrete smoothed inverts same size as pipe up to centerline of pipe. Form perimeter bench as indicated.
 3. Embed steel angles or other accessories as indicated or required to anchor and support frames, grates, or covers.
- B. Frames, Grates, Covers and Steps: Install accurately to placement dimensions shown on drawings. Anchor castings in place and set in adjustment mortar to assure a firm foundation.

3.5 STORM WATER INLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
- B. Construct riprap of broken stone, as indicated.
- C. Install outlets that spill onto grade, anchored with concrete, where indicated.
- D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

3.6 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R.

3.7 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Trenching and Backfilling". Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
 1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.8 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 1. Submit separate report for each system inspection to the Contracting Officer.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.

- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of these specifications.
 - 3. Schedule tests and inspections by the Contracting Officer with at least 72 hours advance notice.
 - 4. Submit separate report for each test to the Contracting Officer.
 - 5. Gravity-Flow Storm Utility Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Option: Test plastic piping according to ASTM F 1417.
 - b. Option: Test concrete piping according to ASTM C924 (ASTM C 924M).
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.9 CLEANING

- A. Clean interior of piping, inlets and manholes of dirt and superfluous materials. Flush with potable water.

END OF SECTION 334100

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SECTION 334600 - SUBDRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes subdrainage systems for the following:
 - 1. Utility Trenches
 - 2. Concrete headwalls and wingwalls
- B. Related Sections:
 - 1. Division 01 Section "Temporary Erosion and Sedimentation Control" for erosion and sedimentation control measures.
 - 2. Division 03 Section "Miscellaneous Cast-in-Place Concrete" for concrete structures
 - 3. Division 31 Section "Earth Moving" for soil materials, site grading, site excavation and filling.
 - 4. Division 31 Section "Storm Utility Drainage Piping" for storm sewer system installation.
 - 5. Division 31 Section "Trenching and Backfilling" for excavating and backfilling of utilities.

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride.

1.4 SUBMITTALS

- A. Product Data: For drainage conduit, drainage panels, and geotextile fabrics.
 - 1. Perforated pipe.
 - 2. Solid pipe.
 - 3. Geotextile fabrics.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to various application articles in Part 3 for applications of pipe, tube, fitting, and joining materials.

2.3 DRAINAGE PIPES AND FITTINGS

- A. PVC Sewer Pipe and Fittings, NPS 15 (DN 375) 15” and Smaller: ASTM D 3034, SDR 35 with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- B. Perforated, PVC Sewer Pipe and Fittings, NPS 15 (DN 375) 15” and Smaller: ASTM D 3034, SDR 35 with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- C. Solid, PVC Weephole Pipe: ASTM D2665, Schedule 80 PVC with bell and spigot ends for weepholes.

2.4 CLEANOUTS

- A. Cast-Iron Pipe: ASME A112.36.2M; with round-flanged, cast-iron housing; and secured, scoriated, Medium-Duty Loading class, cast-iron cover. Include cast-iron ferrule and countersunk, brass cleanout plug.
- B. PVC Pipe: ASTM D 3034, PVC cleanout threaded plug and threaded pipe hub.

2.5 SOIL MATERIALS

- A. Drainage Gravel: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, ASTM D 448, coarse aggregate, Size No. 57, with 100 percent passing 1-1/2-inch sieve and not more than 5 percent passing No. 8 sieve.

2.6 GEOTEXTILE FILTER FABRICS

- A. Subsurface Separation Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M288. Utilize Mirafi 140N or approved equal.

2.7 GEOTEXTILE DRAINAGE FABRIC AND CORE

- A. For use behind headwalls and wingwalls: As specified in CDOT Section 605.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTH MOVING

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Trenching and Backfilling".

3.3 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Trenching and Backfilling". Arrange for installation of green warning tapes directly over piping.
 - 1. Install detectable warning tape and tracer wire over nonferrous piping and over edges of underground structures.

3.4 PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.
 - 1. Retaining-Wall Subdrainage: When water discharges through wall weep holes, pipe may be installed with a minimum slope of zero percent.
 - a. Install as indicated on the drawings.

2. Utility Trench Subdrainage: As indicated on the plans, install perforated piping surrounded by drainage gravel and geotextile separation fabric.
 - a. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends. Subgrade shall be free of rocks and sharp objects that may puncture or damage geotextile.
 - b. Place drainage course 6 inches or less in compacted thickness in a single layer.
 - c. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - d. Lay perforated pipe with perforations down.
 - e. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.
 - f. Backfill perforated pipe to the required thickness shown on the drawings.
 - g. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.
 - h. Contractor is responsible for scheduling installation of utility piping, conduits, ducts, and related appurtenances required by other trades. Do not backfill or complete geotextile fabric installation until all trades have been tested and inspected.
- B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.
- C. Install PVC piping according to ASTM D 2321.

3.5 PIPE JOINT CONSTRUCTION

- A. Join PVC pipe and fittings according to ASTM D 3034 with elastomeric seal gaskets according to ASTM D 2321.
- B. Join perforated, PVC pipe and fittings according to ASTM D 2729, with loose, bell-and-spigot joints.

3.6 FIELD QUALITY CONTROL

- A. Testing: After installing drainage fill to top of pipe, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.7 CLEANING

- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600

SECTION 340100 - MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 RELATED SECTIONS

- A. Division 01 Section "Temporary Facilities and Controls" for temporary utilities and support facilities may be included.
- B. Division 31 Section "Earth Moving" for subgrade preparation.
- C. Division 32 Section "Asphalt Paving" for temporary pavement job mixes.
- D. Division 32 Section "Pavement Marking" for pavement striping and symbols.

1.3 SUMMARY

- A. This work consists of creating temporary traffic control zones to manage the movement of roadway users by furnishing, installing, maintaining, relocating, and removing temporary traffic control devices and services as ordered for the control and protection of public traffic through the project construction zone.
- B. All requirements for maintenance of traffic shall be in accordance with the latest edition of the Manual of Uniform Traffic Control Devices and all reference documents.
- C. The Contractor shall keep the road open to all traffic in accordance with the Contract Documents during the progress of the work. The Contractor shall provide and maintain a safe condition of temporary approaches or crossings and intersections with trails, roads, streets, businesses, parking lots, and residences. The road and the intersections of the access points shall be maintained in a manner that will safely and adequately accommodate traffic.
- D. The Contractor is responsible for coordinating the detour and traffic control plan with the Downtown Estes Loop Phase 1 Improvements project.
- E. The Contractor is required to obtain all required permitting for detours within the Town of Estes Park and Colorado Department of Transportation (CDOT) public right of way.

1.4 SUBMITTALS

- A. Contractor is required to submit a traffic control plan to the Contracting Officer 14 days in advance of construction and will be responsible for ensuring that all relevant codes and regulations are followed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Contractor to provide additional materials as required to manage traffic or as directed by the Contracting Officer.
- B. Barricades: Use barricades of the type and size specified or according to the MUTCD. Use Type III, IV, IX, or XI retroreflective sheeting.
- C. Cones and Tubular Markers: Use cones or tubular markers of the height specified or according to the MUTCD. Use Type III or Type VI retroreflective sheeting.
- D. Construction Signs: Use Type III, IV, VIII, IX, or XI prismatic retroreflective sheeting. Use fluorescent sheeting for orange signs. For roll-up signs, use fluorescent Type VI retroreflective sheeting.
 - 1. Portable sign supports shall be used instead of sign posts when approved by the Contracting Officer.
 - 2. Contractor may install posts as directed or approved by the Contracting Officer.
 - 3. Remove or completely cover unnecessary signs. Use metal, plywood, or other acceptable material to cover signs. Do not use adhesive glues, tapes, or mechanical fasteners that mar the face of the panel of the sign to be covered.
- E. Barrels: Use plastic drums that are at least 36 inches high and at least 18 inches in diameter. Use Type III or Type VI retroreflective sheeting.
- F. Portable Variable Message Sign: In accordance with Section 6F.60 of the MUTCD.
- G. Retroreflective Sheeting: Conform to ASTM D4956, including supplementary requirements.
- H. Flaggers: provide flaggers certified by ATSSA, the National Safety Council, a state department of transportation, or other acceptable organization. Use pilot car operations conforming to the qualification of a flagger.
- I. Temporary Concrete Barriers: Conforming to the requirements of Subsection 606.04 (b) of the CDOT Specifications. Contractor shall install temporary impact attenuators on all exposed blunt concrete barrier ends or as shown on the plans.

Use temporary barriers that are crashworthy and are new or used provided they are not badly damaged. Mount the retroreflectors at a uniform height at least 24 inches above the road surface.

Flexible barrier delineators or barrier delineation tape may be used instead of retroreflectors when approved by the Contracting Officer.

- J. Temporary Pavement Markings or Delineation: Before opening a pavement surface to traffic, remove conflicting pavement markings by sandblasting or other methods that do not damage the surface or texture of the pavement. Make the removal pattern uneven to not perpetuate the outline of the removed pavement marking. Lightly coat sandblasted or removal areas on asphalt surfaces with emulsified asphalt.

Place and maintain temporary pavement markings that are neat, crack free, true, straight, and unbroken.

If temporary signs and pavement markers are substituted for temporary pavement markings, install temporary signs and pavement markers according to the MUTCD and plans.

For temporary pavement markings, use preformed retroreflective tape, traffic paint, or pavement markers as follows:

1. Preformed retroreflective tape: Apply according to the manufacturer's instructions. Remove loose preformed retroreflective tape before placing additional pavement layers.
2. Traffic paint: Do not apply traffic paint to the final surface. Apply traffic paint as the temporary pavement marking if no work will be performed on the project for at least 30 consecutive days. Apply traffic paint at a 15 mil minimum wet film thickness or at a rate of 107 square feet per gallon. Immediately apply Type 1 glass beads on the paint at a minimum rate of 6 pounds per gallon of paint.

Remove temporary pavement markers before placing additional pavement layers or permanent pavement markings. Remove temporary markings after 14 days and apply permanent pavement markings unless approved by the Contracting Officer.

- K. Vertical Panels: Use vertical panels that are at least 24 inches in height and 8 to 12 inches wide. Use Type III, IV, VIII, IX, or XI retroreflective sheeting.
- L. Temporary Crash Cushions and Attenuation Devices: Use a crashworthy temporary crash cushion according to manufacturer's recommendations.
- M. Temporary pavement: Minimum of 5 inches of hot mix asphalt on prepared subgrade as specified in Division 32 Section "Asphalt Paving". Install as indicated on the plans or as needed to support construction activities based on the Contractor's means and methods. Temporary pavements shall be incidental to the work and included in the Contractor's lump sum price for maintenance of traffic.
- N. Steel plates: Use 1-inch or thicker steel plates capable of safely carrying traffic. Secure the plates to the pavement to prevent movement.

PART 3 - EXECUTION

3.1 MAINTENANCE OF TRAFFIC

A. Acceptance

1. Maintenance of traffic work will be evaluated under Division 1 Section “Temporary Facilities and Controls”

3.2 TRAFFIC CONTROL SUPERVISOR

A. The traffic control supervisor(s) must be on-site during all work hours.

B. The Traffic control supervisor(s) will inspect all work zone traffic control devices on the project, including those in staging areas, on-site storage areas, materials sources, and disposal/waste areas as follows:

1. Daily during daylight hours including nonwork days unless otherwise approved by the Contracting Officer.
2. Daily during hours of darkness when nighttime work is being performed.
3. Weekly during the hours of darkness when only daylight work is being performed.
4. Weekly during hours of darkness when work is suspended for periods of more than one week, except when the project has been shutdown for the winter.
5. Additional inspections, day or night, as directed by the Contracting Officer.
6. Before winter suspension, conduct an inspection of the project with the Contracting Officer to ensure proper provisions are made for winter travel during the period of suspensions.
7. During periods of winter suspensions, inspect only as requested by the Contracting Officer.

C. Conduct daily traffic coordination meeting with the Contracting Officer and Park personnel. Meeting time and location to be decided at the preconstruction meeting.

END OF SECTION 340100

SECTION 460713 - WATER TREATMENT PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.
- B. In case of conflict between the drawings and the information specified herein, the most stringent requirements shall govern.
- C. Work covered by this section shall be completed in conformance with NPS Reference Manual – 83A Public Health: Protection and Prevention (2018).
- D. Related Sections:
 - 1. Division 03, Section “Miscellaneous Cast-in-Place Concrete”
 - 2. Division 22, Mechanical Systems
 - 3. Division 26, Electrical Systems
 - 4. Division 31, Section “Water Utility Distribution Piping”

1.2 SCOPE OF WORK

- A. Contractor shall furnish a complete water treatment system for this project. The system shall include raw water from a water supply well with a pressure gauge, flow meter, valves, two (2) sample ports, chlorine disinfection system and related items necessary for a complete and operational potable water treatment system. Replacement in kind of the existing well pump and sanitary seal is included in this project as well.

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Raw Water Quality. Provide a treatment system capable of treating potable groundwater, to the levels required by NPS Reference Manual – 83A, with the following characteristics and performance requirements:
 - 1. Continuous service flow rate: 10 gallons per minute (gpm)
 - 2. Sodium hypochlorite residual: 0.2 milligram per liter (mg/L)
 - 3. Average sodium hypochlorite dose rate: 0.06 gallons per day (GPD)

1.4 SUBMITTALS

- A. Submit product data on pumps, control equipment, control panels, valves, piping, electrical components, and all accessories to verify compliance with specifications.
- B. Submittals shall include manufacturer’s literature and installation recommendations, at a minimum. Submittals for the following pieces of equipment shall also include:

1. Well Pump
 - a. Performance curve and rated capacities
 - b. Materials of construction
 - c. Maximum working pressure
 - d. Motor type and voltage requirements

2. Chemical Feed Pump
 - a. Manufacturer name
 - b. Materials of construction
 - c. Flow rate output control
 - d. Maximum working pressure
 - e. Maximum suction lift
 - f. Motor type and voltage requirements

3. Diaphragm-Type Pressure Tank
 - a. Manufacturer name
 - b. Dimensional drawings including minimum clearances
 - c. Tank volume
 - d. Diameter of inlet/outlet
 - e. Materials of construction
 - f. NSF 61 certification for all wetted parts
 - g. Recommended spare parts list
 - h. Installation assembly/disassembly and repair instructions
 - i. Protective coating system

- C. Product Certificates and Warranties: For each type of pump, tank, and other treatment equipment, signed by the product manufacturer.

- D. Operation and maintenance manuals:

Provide five complete sets of loose-leaf operating and maintenance manuals. These manuals shall not only include descriptive material, but also drawings and figures bound in appropriate places. The manuals shall include operating and maintenance literature for all components provided in this section. The submitted literature shall be in sufficient detail to facilitate the operation, removal, installation, adjustment, calibration, and maintenance of each component provided under this section.

1. Chemical Disinfection Dosing System
2. Diaphragm-type pressure tank
3. Control systems
4. Valving and Appurtenances
5. Well Pump

1.5 QUALITY ASSURANCE

- A. Treatment equipment shall be the product of a company who has been regularly engaged in providing similar equipment for a minimum period of 5 consecutive years.

- B. Provide the services of a Company representative for a minimum of 4 working hours for system startup and training to include the following:
 - 1. Render advice regarding installation and final adjustment of each piece of equipment.
 - 2. Witness final system test and then certify with an affidavit that the equipment is installed in accordance with the contract documents and is operating properly.
 - 3. Train facility personnel on the operation and maintenance of the system.
- C. Source Limitations: Equipment of a single type shall be from a single manufacturer.
- D. Manufacturers shall adhere to ISO 9001 International Quality Control Standards, regularly reviewed and audited by a third-party registrar.

1.6 DELIVERY, STORAGE, HANDLING, AND INSTALLATION

- A. The manufacturer is responsible for the safe delivery of the equipment and appurtenances to the site. The Manufacturer/Contractor is responsible for disinfecting the system after installation at the site in accordance with the contract documents and the project Disinfection and Sampling Plan. The manufacturer is responsible for providing trained personnel for system checkout after installation as well as training of Government and operators.
- B. The Contractor is responsible for installing the treatment system, and providing and installing all necessary piping, wiring, and conduit to and from the treatment system.
- C. The Contractor is responsible for off-loading of equipment and the safe on-site storage of the system prior to the installation.
- D. Handling of the equipment and appurtenances shall be done in a manner to prevent any damage to the equipment or any of the associated parts. Damaged equipment is the responsibility of the Contractor and shall be repaired or replaced in kind.
- E. Contractor shall furnish the treatment building enclosure for the system. Minimum space requirements shall be specified by the Government and operators and are indicated in the drawings and the basis of design.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE WELL PUMP

- A. Description: Submersible, stainless steel well pump complying with Hydraulics Institute (HI) 2.1 – 2.2 and HO 2.3; with the following features:
 - 1. Impeller Material: Stainless steel
 - 2. Motor: Capable of continuous operation under water, with protected submersible power cable.
 - 3. Provide Goulds model number 10GS07 or approved equal.

B. Capacities and Characteristics

1. Duty point flow rate: 10 gpm
2. Duty point Total Dynamic Head: 250 ft
3. Discharge Size: 1 ¼"
4. Motor Horsepower: ¾ hp
5. Lift: 100 ft
6. Stages: 14
7. Electrical: 230 V/1 ph/60 Hz

2.2 WELL SEAL

- A. Description: Well seal shall be constructed with an ABS body and PVC gasket, compatible with a well casing inside diameter of 4" and a 1 ¼" diameter drop pipe. Well seal shall be Campbell model number PS4X1 1/4 or approved equal.

2.3 VALVES

- A. Ball Valves: All ball valves larger than ¼" - 2" shall be manually operated lead-free bronze design with threaded ends and be compatible with associated piping. Valves shall be suitable for 150 psi working pressure. All bronze ball valves shall be as manufactured by Nibco or approved equal. Valves or all wetted parts shall be NSF 61 approved.

2.4 PIPING, TUBING, AND FITTINGS

- A. All water treatment system face process piping and fittings shall be schedule 80 PVC. Instrument tubing shall be ¼" polyethylene. Sample port tubing shall be 1/8" 304 stainless steel. Sample ports shall be smooth nosed.

2.5 SODIUM HYPOCHLORITE CHEMICAL DOSING SYSTEM

- A. Chemical dosing system shall be tank-mounted single head adjustable peristaltic pump and associated tubing to inject liquid sodium hypochlorite solution into the water supply pipe for disinfection treatment for potable water.
- B. Peristaltic pump shall be Stenner Pumps model number 45M1, or approved equal, and have the following design parameters:

Chemical Dose Flow Rate:	0.06 gph duty rate (0.01 – 0.13 gph range)
Pump Tubes:	1
Controls:	Feed rate control by an external dial ring that is labeled L to 10 offering an adjustable output range from 5% to 100% in 2.5% increments
Maximum Working Pressure:	25 psi (17 bar)
Motor Type:	1/30 HP
Duty Cycle:	Continuous
Voltage:	120V 60 Hz 1 PH

C. Peristaltic pump materials of construction shall be as follows:

All Housings:	Polycarbonate
Pump Tube:	Santoprene ® (FDA approved) or Versilon ®
Pump Head Rollers:	Polyethylene
Roller Bushings:	Oil impregnated bronze
Suction/Discharge Tubing, Ferrules:	Polyethylene, FDA approved
Tube and Injection Fittings:	PVC or Polypropylene, NSF listed
Connecting Nuts:	PVC or Polypropylene, NSF listed
Suction Line, Strainer, and Cap:	PVC or Polypropylene, NSF listed with Ceramic Weight
All Fasteners:	Stainless steel

D. Peristaltic pump shall be mounted on a 7.5-gallon white polyethylene (approved to NSF/ANSI 61) chemical storage tank, Stenner model number STS7NC, or approved equal. Tank shall be equipped with a polypropylene lid with child resistant lock. Pump shall be mounted with stainless steel screws and Viton grommets. Tank shall be translucent white in color.

E. Chemical dosing system shall be controlled by a pressure switch located just upstream of the chemical injection tap. When the pressure switch operates to refill the pressure tank, the chemical dosing pump will also be signaled to operate.

2.6 STATIC MIXER

A. Static mixer shall be Koflo model number 1-40C-4-12-2 or approved equal.

B. Static mixer shall be constructed of Schedule 40 Clear PVC with 12 fixed mixing elements and 1" male NPT threaded ends.

2.7 DIAPHRAGM-TYPE PRESSURE TANK

A. Manufacturers:

1. Well-X-Trol WX-250 by Amtrol of Worthington Industries, Inc., West Warwick, RI.
2. Or approved equal.

B. Pressure Tank Specifications:

1. Durable NSF 61 compliant diaphragm made of heavy-duty butyl or other approved material.
2. Steel tank construction.
3. Provide 1 pressure tank as indicated on the drawings.
4. Pressure rating of tank shall be at least 150 psig.
5. Pressure tank shall come factory pressurized. Adjustments may be necessary to achieve performance specifications. Equipment and labor used to adjust tank shall be included in the bid price.
6. Tank shall be 44 gallons total volume. Drawdown achieved per tank is to be at least 11.8 gallons at the 40 / 60 psig setting.
7. Pressure tanks shall be constructed according to ASME standards (RCW 70.79.080 (5)).

8. Pressure tanks shall have a properly sized and installed ASME Section VIII pressure relief valve.

2.8 PRESSURE SWITCH

- A. Manufacturers:
 1. Square D Schneider Electric – Water Pump Switch 9013FYG2J33 – 40-60 psig.
 2. Or approved equal.
- B. A pressure switch is to be provided in the water treatment building with 40 / 60 psig on/off settings.

2.9 WATER METER

- A. Manufacturers:
 1. Neptune – 1” nutating disc, positive displacement meter (see drawings)
 2. Or approved equal.
- B. Water Meter Requirements:
 1. Water meter shall meet requirements of AWWA C700.
 2. NSF/ANSI 61 & 372 certified.
 3. Accuracy of +/- 1.5% for 1 gpm through 50 gpm.
 4. Lead free, high-copper alloy, corrosion resistant maincase.
 5. 150 psi operating pressure.
 6. Encoder register, with 8-digit remote meter reading and 8-wheel mechanical odometer.

PART 3 - EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.
- C. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times.

3.2 EXAMINATION

- A. Examine substrates and conditions, with contractor present, for compliance with requirements for installation tolerances and other conditions affecting performance.

- B. Examine roughing-in of piping systems to verify actual locations of piping connection before domestic water treatment system installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Remove existing well seal and well pump from well. Install new well pump using the existing drop pipe and well casing. Protect the well head from contamination throughout construction. Replace well seal with new well seal and provide electrical connections in the well head junction box as required.
- B. Install water treatment system components where indicated, according to specific equipment and piping arrangement indicated.
- C. Valve Screwed Ends:
 - 1. Clean threads by wire brushing or swabbing.
 - 2. Apply join compound.
- D. Valve Orientation
 - 1. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4'-6" or less above finished floor, unless otherwise shown.
 - 2. Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 4'-6" and 6'-9" above finished floor, unless otherwise shown.
 - 3. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.

3.4 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified.
- B. Ground equipment according to Division 26 specifications.
- C. Connect wiring according to Division 26 specifications.

3.5 IDENTIFICATION

- A. Install identifying labels permanently attached to equipment.
- B. Label circuit breakers on panel.

3.6 FIELD QUALITY CONTROL

- A. Contractor shall notify Contracting Officer a minimum of 48 hours before conducting any testing.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Tests and Inspections
 - 1. After installing domestic water treatment system and after electrical circuitry has been energized, test for compliance with requirements. Furnish water required for pump tests.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 4. Valves may be either tested while testing pipelines, or as a separate step.
 - 5. Test that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, in both directions for two-way valve and applications.
 - 6. Automatic valve to be tested in conjunction with control system testing.
- D. Remove and replace any components that do not pass tests and inspections and retest as specified above.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain the water treatment system.
- B. Operation Instruction and Training: The contractor shall provide on-site operation instruction to the operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the hardware, software, and accessories.

3.8 MANUFACTURER'S CERTIFICATES

- A. Provide manufacturer's certificate(s).

3.9 WARRANTY

- A. Warranty for water treatment equipment shall be in accordance with Division 1 of these specifications.

END OF SECTION 460713