Smithsonian Institution

Office of Engineering Design & Construction

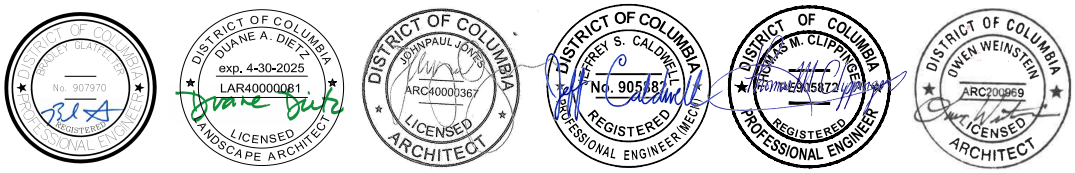
SPECIFICATIONS

PROJECT NO.: **2033108**

PROJECT TITLE: **Renew Cheetah Conservation Station-Africa Trail (CCS-AT) – KUDU**

FACILITY: **Smithsonian National Zoo and Conservation Biology Institute**

DATE: 11/03/2023
Kudu MOD 4 Final Submission



This project is approved as being in conformance with applicable provisions of the Smithsonian Directive (SD) 410.

Michael J. Carrancho, P.E., Associate Director Date

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Washington, D.C. 20560
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SECTION 01000

SUPPLEMENTARY CONDITIONS FOR CONSTRUCTION

PROJECT SUMMARY AND INFORMATION

1. PROJECT INFORMATION

1.1. SF Project No. **2033108**
NZP-DC: Renew Cheetah Conservation Station -KUDU Yard
National Zoological Park
3001 Connecticut Avenue, NW
Washington, D.C. 20008

Smithsonian Institution Contacts:

Contracting Officer (CO), address for Fed Ex and UPS delivery:
Smithsonian Institution
Office of Contracting
600 Maryland Avenue, SW, Suite 500E
Washington, DC 20024

Contracting Officer (CO), address for USPS delivery:
Smithsonian Institution
Office of Contracting
MRC 1200
P.O. Box 37012
Washington, DC 20013-7012

Contracting Officer's Technical Representative (COTR), address for Fed Ex and UPS delivery:
Smithsonian Institution
Attn: Marc Muller, Office of Planning, Design & Construction
General Services Building
National Zoological Park
3001 Connecticut Avenue, NW
Washington, DC 20008

Contracting Officer's Technical Representative (COTR), address for USPS delivery:
Smithsonian Institution
Attn: Marc Muller, Office of Planning, Design & Construction
General Services Building
National Zoological Park
3001 Connecticut Avenue, NW
Washington, DC 20008

2. SUMMARY OF WORK

2.1. Furnish all supervision, labor, materials and equipment needed to do the project work at the following location at the Smithsonian Institution's National Zoological Park (NZP) located at 3001 Connecticut Ave NW Washington DC 20008:

2.2. The work includes but is not limited to:

a. Selective demolition of fencing, concrete, and trees to accommodate new systems.
b. Re-grade and installation of new curbs, retaining wall, concrete paving, fencing, caging, gates, gate control system, and security infrastructure.
c. Installation of new substrate, deadfall, planting, irrigation system, and hot wire conduit.
d. Re-paint and installation of new flooring, gutters, and downspouts, at barns.
e. Installation of new BAS monitoring system, improvements to mechanical systems.
f. Installation of new conduit and electrical power equipment.

ASI-003 is issued at the request of SI to add Scope to the existing project. This Scope includes but not limited to:

a. Reconfiguration of the Kudu holding yard and transfer area
b. Addition of a new hornbill barn
c. Addition of new hornbill outdoor enclosed area
d. Replacement of floor drains kudu
e. Replacement of Kudu Barn heating system
f. Relocation and re-installation of Tamer from CCS-AT main campus
g. Improved drawing coordination with ongoing security fence project
h. Grading, planting, and irrigation, as shown.

When Contractor has completed and checked his work, he or she will contact COTR for an inspection. Contractor shall clean up and dispose all debris associated with job. Contractor will be responsible for all labor, materials, and equipment to complete project.

This short description, however, shall not, in any way, be construed to limit the Contractor's obligation for compliance with the Contract specifications.

2.3. Critical Elements of the Work: The successful Contractor shall be fully qualified to install critical elements of the Work. Bidders shall submit a statement of qualifications to address the following:

2.3.1 All installers qualification shall have a minimum of five (5) years in the industry and may be requested to provide three (3) projects of similar task upon request from COTR

2.3.2 Experience in coordinating work tasks around an operational campus.

2.3.3 All site staff safety trained with a strong commitment to implementation to "Project Safety"

3. CONTRACT TIME FOR COMPLETION

3.1 Work under this contract shall begin by the Contractor within seven (7) calendar days after the Notice to Proceed and shall be completed within the total contract time of 210 calendar days. All work, including inspections, testing, correction of deficiencies, and project close-out activities, shall be completed in every respect within the Contract time.

3.2 The start date and completion date shall be as stated in the Notice to Proceed issued by the Contracting Officer.

4. SCHEDULE OF OPTIONS FOR BID

4.1 The following is a brief statement of the Work identified for bid/proposal options. The complete description of the Work is identified elsewhere in the drawings and specifications.

BID OPTION/PROPOSAL:
Demolition of existing asphalt shingles and installation of new asphalt shingles at Kudu Barn,

5. SCHEDULE OF UNIT PRICES – NOT USED

6. BIDDER/OFFEROR EXAMINATION OF SITE

6.1. Every effort was made to indicate all work necessary to complete the project as identified. All bidders must carefully examine the premises during the bid period and satisfy themselves as to the extent, nature and location of the work, general and local conditions, particularly those bearing on transportation, disposal, handling and storage of materials, availability of labor, water, electric power, access routes, uncertainties of the weather, type of equipment and facilities needed for the successful execution of the Work.

6.2. Pre-Bid Conference and Site Visit. Before the bid opening date, a scheduled pre-bid conference and site visit will be announced by the Contracting Officer. The purpose of the scheduled meeting is to provide an opportunity for all bidders to review the project site. Any comments, information or discussion during the site visit shall not modify the Contract Documents.

6.3. This project requires special arrangements for access to a non-public area. Access to the site may be restricted at times other than during the scheduled visit. Coordinate access with COTR.

7. AVAILABILITY OF DOCUMENTS

7.1. The bidder may obtain a compact disc with electronic versions of drawings and specifications from:

Smithsonian Institution
Office of Engineering Design and Construction
600 Maryland Avenue, SW., Suite 5001
Washington, DC 20560

7.2. The bidder is responsible for making their own hard copies of the solicitation documents.

SPECIAL PROJECT REQUIREMENTS

8. UNITS OF MEASURE

8.1. All fabrication and installation shall be performed in accordance with the units of measure given in the Contract Documents. Units of measure on this project are Imperial units.

9. NON-PUBLIC, TENANT AND SECURED SPACES

9.1. Certain tenant spaces, non-public spaces, utility and equipment rooms and other areas related to or used for purposes of storage, conservation, research, curation of NZP collection and artifacts or for scientific research may have restricted access.

9.2. Identify to the COTR as soon as possible, but no less than two (2) workings days in advance, any occupied areas that the Contractor must access that are located outside the limits of the project site. The Contractor shall identify in writing:

9.2.1. Restricted areas to be accessed.

9.2.2. Specific reason for needing access.

9.2.3. Nature of the work to be performed.

9.2.4. Date(s) and hours needed to complete construction work activity.

10. NZP ARTIFACTS AND SCEINTIFIC RESEARCH MATERIALS [NOT USED]

11. PROTECTION OF HISTORIC PROPERTIES

11.1. The project site is located in a designated National Historic Landmark property and requires special attention to the quality of materials selected for installation and workmanship efforts to satisfactorily preserve and restore historic elements and finishes of an historic landmark structure.

11.2. Upon request of the COTR, the Contractor shall submit evidence of technical competence in restoration work for National Historic Landmark structures, including subcontractor resumes, references and photographs or previous similar work.

11.3. Without exception, all original building fabric of the National Zoological Park is designated historic.

12. COMMITMENT TO SUSTAINABILITY

12.1. The Smithsonian Institution is a trust instrumentality of the United States (recognized as a tax-exempt organization under Section 501(c)(3) of the Internal Revenue Code) and although not an Executive Branch of the U.S. Government, is committed to planning, designing, constructing, maintaining and operating its owned and leased buildings and facilities consistent with Federal environmental and energy management requirements, as listed in the Smithsonian SF Codes, Standards and Guidelines document dated February15,2021, to the maximum extent practical.

13. COMMISSIONING NOT USED

CONTRACTOR USE OF PREMISES

14. HOURS OF WORK, WORKDAYS AND GOVERNMENT HOLIDAYS

14.1. Work shall be performed, under this Contract, during the normal workdays of Monday through Friday, except Smithsonian holidays and special events as specified herein and the normal work hours, TBD at Pre-construction Meeting. The NZP opens to the public at 8:00 a.m. daily, and use of public trails, roads, walks, etc. are limited during public hours and during special events. Coordinate with COTR.

14.2. The premises will be continually occupied, requiring that certain work under this contract may need to be performed during periods other than that specified above. All shutdowns and outages must be approved by and coordinated with the COTR and occur between the hours of 6:00 p.m. to 6:00 a.m., unless otherwise approved.

14.3. For each occasion the Contractor intends to work on Saturdays, Sundays or Smithsonian holidays or during hours other than those indicated above, the Contractor shall obtain written permission from the COTR, at least three (3) working days in advance.

14.4. The Contractor shall reimburse the Smithsonian Institution for security and inspection services provided by the Smithsonian when the Contractor chooses to work outside the normal workdays and hours, as identified herein. However, the Contractor will not be charged for NZP overtime security and inspection services, if in the opinion of the COTR, the work cannot be done during the normal workdays and hours due to requirements of the Smithsonian.

14.5. Smithsonian Holidays: For holidays that fall on Saturday, the Smithsonian holiday is observed on the previous Friday. For holidays that fall on Sunday, the Smithsonian holiday is observed on the following Monday. The Smithsonian Holidays are listed below. Also see the National Zoological Park website for a listing of special events.

New Year's Day	January 1
Martin Luther King Jr.'s Birthday	January, third Monday
George Washington's Birthday	February, third Monday
Memorial Day	May, last Monday
Juneteenth National	June 19
Independence Day	July 4
Labor Day	September, first Monday
Columbus Day	October, second Monday
Veterans' Day	November 11
Thanksgiving Day	November, fourth Thursday
Christmas Day	December 25
President's Inauguration Day	January 20, 2025

15. CONDITIONS AFFECTING CONTRACTOR'S WORK

15.1. Existing Occupied Spaces: The premises will be occupied during the performance of the Work. The Contractor shall schedule work activities to minimize interruption of occupants and occupied spaces. Efforts will be made to temporarily move employees and contents out of specific areas under construction, as needed, during the times requested by the Contractor. However, the needs of the Smithsonian Institution take precedence and free access for the Contractor cannot always be guaranteed. The Contractor may work in animal areas only in the presence of authorized Smithsonian staff or guard personnel. Areas that will remain occupied include the grounds of the NZP.

15.2. Relocation of Existing Occupants: [NOT USED]

15.3. Space for Contractor Use: The space available for Contractor's use shall be coordinated with COTR at the project site. Space allocation and availability are subject to change, at the discretion of the Smithsonian, to meet the needs of all parties requiring access and space within the building, work area, and the surrounding areas.

16. CONTRACTOR DELIVERIES, HAULING AND ACCESS

16.1. Normal deliveries shall be made between the hours of 6:00 AM and 10:00 AM. The Contractor's materials and equipment shall be delivered, received, receipted for and handled by the Contractor's personnel.

16.2. Access to the site for on- and off-loading of all material, structures and equipment shall be designated by the COTR.

17. DRESS AND DEPORTMENT

17.1. Contractors' personnel shall be fully and appropriately clothed at all times and shall conduct themselves in a manner appropriate to a public place. The COTR may require removal of any individual from the premises and project for unacceptable dress, demeanor or disruptive conduct, if the Contractor superintendent fails to correct conditions in violation of this paragraph.

17.2. The Government reserves the right to exclude or remove from the site or building any employee of the Contractor or Subcontractor as the Government deems incompetent, careless, insubordinate, or otherwise objectionable, or whose continued employment of the work is deemed by the Government to be contrary to public interest.

18. CONTRACTOR PARKING

18.1. One parking space will be assigned to the Contractor for use during the contract period. The space will be located as close to the project site as possible. Coordinate with COTR.

18.2. NOT USED

18.3. The assigned space can only be used by the company vehicle. The vehicle must be clearly marked with company name and/or logo. The permit shall be displayed on the vehicle dashboard on the driver's side. Vehicles not in compliance with this clause are subject to ticketing and towing by the NZP police. Costs associated with parking violations shall be the sole responsibility of the Contractor.

18.4. Parking spaces will not be provided for the Contractor’s employees. Employees will be required to comply with the NZP’s pay parking regulations.

18.5. Arrangements for Contractor's parking are the sole responsibility of the Contractor. Parking may not be available at the project site.

19. EATING, DRINKING, SMOKING AND ILLEGAL SUBSTANCE USE

19.1. Eating and drinking in Smithsonian buildings or leased space will be allowed only in designated areas. Offenders may be subject to removal from the premises and project should the

Contractor's Superintendent fail to correct conditions, which, in the opinion of the COTR, violate this clause.

19.2. Gambling and the consumption of alcoholic beverages by the Contractor's personnel is prohibited in all Smithsonian facilities.

19.3. Smoking, vaping, using E-cigarettes or carrying lighted tobacco products is prohibited in all Smithsonian buildings or leased space, in exhibition and public spaces, in areas where hazardous materials are stored or handled and in areas undergoing construction, renovation or repair. Acceptable areas for smoking are outside of the building, as designated by the Smithsonian Facility Manager, and/or Office of Safety, Health, and Environmental Management (OSHEM).

19.4. The possession, sale and/or use of narcotics or other illegal substances or firearms by Contractor employees are strictly prohibited in all Smithsonian facilities and leased space. Contractor employees are strictly prohibited from working on the project under the influence of alcohol and/or illegal substances. Contractor employees in violation of any of the above prohibitions will be removed from the project.

PROJECT COORDINATION

20. COORDINATION OF TRADES

20.1. Coordinate work of different trades so that interference between mechanical, electrical, architectural and structural work, including existing services, shall be avoided.

20.2. [NOT USED]

20.3 Where work by separate entities requires off-site fabrication of products and accurate interfacing of materials to produce the required results, the Contractor shall prepare coordination drawings to indicate how work shown on separate shop drawings will be interfaced, intermeshed and sequenced for installation. Coordination drawings shall be submitted in accordance with the requirements of the "Submissions" section.

20.3.1. Work installed prior to approval of coordination drawings shall be at the Contractor's risk. Subsequent relocations required to avoid interferences shall be made without additional expense to the Smithsonian. If an interference develops, the COTR will decide which work shall be relocated, regardless of which was installed first.

20.4. Installation of equipment and systems shall allow the maximum practical space for operation, repair, removal and testing, within the limits indicated on the Contract Documents. Pipes, conduit, ducts and other system components shall be installed as close as possible to ceiling slabs, walls and columns to minimize space used while accommodating function and maintenance.

21. QUALITY CONTROL

21.1. Provide qualified site personnel responsible for quality control, inspections, testing and re-testing as necessary for all work, including that of Subcontractors, to assure compliance with the Contract Documents.

21.2. Testing Requirements: Except as specifically stated otherwise, the Contractor shall be responsible for all field sampling and in-place testing required by the Contract Documents.

21.2.1. Independent Testing Laboratory: The Contractor shall provide an independent, commercial testing laboratory to perform all sampling and testing services required, unless otherwise specified. The testing services shall be on- or off-site as required. Submit complete documentation of all tests performed in connection with the Construction Contract.

21.2.2. Smithsonian Acceptance of Laboratories: Except for factory tests, all field sampling and testing normally performed by commercial laboratories shall be performed by an independent commercial laboratory employed by the Contractor and accepted by the COTR. The Contractor shall submit the following information to the COTR for approval:

21.2.2.1. Name, registration number and engineering discipline of the Registered Professional Engineer in charge of the laboratory.

21.2.2.2. Affidavit of compliance and certification that the laboratory performs work in accordance with requirements as stated in the Contract Documents.

21.2.2.3. A list of testing equipment proposed for each test procedure including latest calibration data.

21.2.2.4. A copy of the latest Laboratory Inspection Report by an independent agency with laboratory certification that deficiencies (if any) have been corrected.

21.2.2.5. Names and qualifications of persons actually performing testing and sampling. Changes in personnel shall be approved by the COTR prior to performance of work under this contract.

21.3.4. Test Results: Test results shall cite the Contract requirements; the test or analytical procedures used the actual results and include a statement that the item tested or analyzed conforms or fails to conform to specification requirements. The cover sheet for each report shall be conspicuously stamped in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, as the case may be. All test reports shall be signed by a testing laboratory representative authorized to sign certified test reports. The Contractor shall arrange for immediate and direct delivery of the signed reports, certifications and other documentation to the COTR.

21.8. Documentation: The CQC shall prepare or assist with the preparation of the following documents:

21.8.1. Daily Reports: The Contractor's Daily Report, as discussed in the section Contractor Correspondence and Daily Reports, shall be signed by the CQC Representative as well as the Superintendent. The CQC Representative's signature certifies that, to the best of his or her knowledge, the report is complete and correct and that all materials, equipment and work described on the report are in compliance with the contract plans and specifications, except as noted otherwise.

21.8.2. Special Inspection and Documentation: Reports of Special Inspections shall be signed by both the CQC Representative and the CQC Specialized Supplemental Person who witnessed the test or inspection certifying compliance with the specific contract requirement.

21.8.3. As-Builts: The CQC Representative shall ensure that all requirements for as-built record drawings and specifications are met. The CQC Representative or Specialized Supplemental Personnel assigned to inspect that particular portion of work shall initial each as-built drawing or technical specification section to certify its accuracy prior to submission in accordance with the Project Close-Out Requirements section.

22. PERMITS, LICENSES& FEES

22.1. Obtain and pay for all applicable permits and licenses required by D.C. regulating agencies, including but not limited to: storm water management, water quality as it relates to Rock Creek disturbance, etc.

22.2. Pay all duties, fees, taxes and other charges and give all notices necessary and incidental to the due and lawful execution of the work.

22.3. Keep the Smithsonian indemnified against all penalties and liability for breach of provisions of any national, provincial, district or city statute, ordinance or law and the regulations and by-laws of any local or other duly constituted authority, which may be applicable to the Work and with such rules and regulations of public bodies and companies.

22.4. Accessibility for Physically-Disabled Persons: Provide temporary constructions at the site as necessary to maintain access for physically disabled persons. All provisions for temporary access shall be subject to the approval of the COTR.

23. UTILITY SERVICE INTERRUPTIONS AND NEW CONNECTIONS

23.1. Any planned interruption in utility service must be approved by and coordinated through the COTR. The Contractor shall submit a written request as far in advance of scheduled interruption as possible, but no less than two (2) full working days in advance. The Contractor shall make the necessary temporary provisions to supply continuous electrical power and security as required during periods when service is interrupted.

23.2. Work shall be coordinated to minimize the number and duration of outages.

23.3. All planned shutdowns and outages must occur between the hours of 6:00 p.m. to 6:00 a.m., unless otherwise approved by the COTR.

23.4. The Contractor's work efforts to restore service shall be continuous until the interrupted utility is back in service.

23.5. The electrical power for *Lion /Tiger may not be interrupted without advanced coordination with the COTR.

23.6. A fire watch shall be provided for the time periods when fire suppression and detection systems are out of service.

24. SMITHSONIAN-FURNISHED ITEMS INSTALLED BY THE CONTRACTOR [NOT USED]

25. SALVAGE

25.1. The Smithsonian Institution assumes no responsibility for salvage value or any loss or damage to materials or structures on the site for which the Contractor may have reflected a salvage value in his or her offer.

25.2. Except as specifically stated in the Contract Documents, construction materials, equipment or other items that are to be removed and neither re-used under this Contract nor reserved as property of the Smithsonian Institution shall become the property of the Contractor and shall be removed from the premises by the Contractor.

26. CUTTING, PATCHING AND MATCHING EXISTING WORK

26.1. Existing work shall be cut, drilled, altered, removed or temporarily removed and replaced as necessary for performance of work under the contract. Work that is replaced shall match similar existing work. Structural members shall not be cut or altered, except where noted on drawings, without authorization of the COTR. Work to remain in place, which is damaged or defaced during this Contract shall be restored to match the conditions existing at the time of award of the Contract, at no additional cost to the Smithsonian.

26.2. Conditions exposed by removal of existing work that do not match new finishes or align with new work shall be called to the COTR's immediate attention. Necessary corrective work directed by the COTR will be subject to adjustment provisions as stated in the General Conditions of the Contract.

PROTECTION OF THE SITE DURING CONSTRUCTION

27. PROTECTION OF THE SITE

27.1. Provide adequate protection for all parts of the facility building, including interior and exterior surfaces, its occupants and contents and grounds wherever work under this Contract is performed.

27.2. Plan for Protection of the Site: The Contractor shall submit a plan for protection of the site to the COTR for approval. As a minimum, the Plan shall describe:

27.2.1. Proposed method, location and construction of temporary enclosures.

27.2.2. Routes of access and egress, including those for people with disabilities.

27.2.3. Location and maintenance of emergency exits.

27.2.4. Methods of protection of existing surfaces and occupants.

27.2.5. Means of connection of temporary enclosures/surfaces to existing historic materials.

27.3. [NOT USED]

27.4. During construction, temporary enclosures shall be constructed to prevent unauthorized access or egress. Dust and fume barriers shall be constructed, as needed or as determined by the COTR, to seal and isolate the work area from the remainder of the interior areas while the work is in progress. Wood used for protection of the site shall be pressure-impregnated, fire-retardant. All plastic sheeting shall be fire retardant 6-mil polyethylene. Submit product data to the COTR for review and approval.

27.5. Submit information describing the proposed construction of temporary enclosures and methods of installation to the COTR for approval. Any connections to existing structures must be accomplished in such a way as to minimize disturbance of existing surfaces.

28. PROTECTION OF FLORA, FAUNA AND IRRIGATION SYSTEM

28.1. Flora Protection: The Contractor is expressly prohibited from collecting plant materials on Smithsonian property.

28.2. The Contractor shall not store materials inside the drip-line of trees or shrubs. Prior to the start of the work on site, the Contractor shall surround trees within the project site and adjacent areas with a protective 6-foot-high chain link fence located 12 inches outside the drip line (minimum).

28.3. Vehicular traffic inside the drip-line of trees, on turf areas or on flowerbeds is not permitted without prior approval of the NZP's Department of Horticulture through the COTR. If flowerbeds must be crossed by vehicles, bridging is required. Bridging shall be 4 inches thick timbers 2 layers of ¾ inch exterior grade plywood or 2" x 10" or 1" protective plastic decking [such as Bravo mat or equal] to help prevent soil compaction of the soil in the lawn areas and flowerbeds. Any turf area used for parking with prior approval as noted above must first be planked by the Contractor.

28.4. Where aerial work is being performed above flower/shrub beds, the Contractor shall protect them with an approved protective framework installed at least 12 inches above the tops of

the plant materials. The Contractor shall submit the proposed method of protection to the COTR for approval. Trees and shrubs shall only be tied back with the approval of the COTR.

28.5. Any damage to the existing irrigation systems during construction shall be repaired by the Contractor within two calendar days from when the damage occurred.

28.6. NOT USED

28.7. Bear all costs for repairs to the damaged irrigation system. Where the low voltage control wiring is damaged due to construction, then said wiring shall be replaced from the zone valve to controller. No splicing will be permitted.

28.8. Identification tape, when damaged, shall be replaced with an identification wire from valve to controller.

28.9. All damaged irrigation piping shall be cleared of debris prior to making the connections.

28.10 Bear all costs for replacement of damaged plant materials. Replacement plant materials shall meet the criteria established by the NZP's Department of Horticulture.

28.11. Plant material removed by the Contractor for reuse shall be balled, bagged and protected in accordance with instructions prepared by the NZP's Department of Horticulture.

28.12. Turf areas damaged during construction shall be repaired by the Contractor meeting the standards shown in Specification Section 32 92 00 Turf and Grasses for recommended soil improvements, sod species, and sod installation instructions.

28.13. The Contractor shall be responsible for the daily removal of trash and construction debris from turf and flower/shrub beds within the limits of construction.

28.14. Any plant material destroyed and/or damaged by the Contractor during construction shall be replaced with like genus and species of the same size, at no additional cost to the Smithsonian. The damaged plant materials must be replaced prior to final payment. The same applies to artifacts or furniture collection pieces. The COTR requires five (5) working days' notice should any of the artifacts or furniture collection need to be removed to facilitate construction.

28.15. Any construction scaffolding on turf and planted beds must be coordinated with the NZP's Department of Horticulture, through the COTR, to ensure that its installation will not damage or destroy existing plant materials or turf area or interfere with daily maintenance of the grounds. Trees may be tied back to permit scaffolding erection, no more than 4 feet if possible. The tying back must be performed by a certified Arborist with the approval of NZP's Department of Horticulture through the COTR. Where scaffolding is necessary to facilitate construction, NZP's Department of Horticulture requires a three (3) workday notice for said work.

28.17. Fauna Protection: The Contractor is prohibited from hunting, collecting or feeding animals on Smithsonian property. All food and food wrapping brought on the premises must be properly disposed of in approved containers, which are secured from animals.

28.18. If a generator is placed on the turf, Contractor must have the COTR's approval of its placement. Generator shall be placed on anti-compactor boards. The generator must be placed in a drip containment basin.

28.19. [NOT USED]

28.20. Topsoil: ASTM D 5268, fertile, naturally sandy loam as defined by USDA Handbook no. 18, Figure 38. It shall be natural, surface soil in a friable condition and contain less than 3% subsoil. The topsoil shall be free of hardpan material, stones and clods larger than ½ inch in diameter, sticks, tree or shrub roots, debris, toxic substances (e.g. Residual herbicides) and other material detrimental to plant growth. The area and the topsoil shall be free of plant or plant parts of undesirable plants such as, but not limited to, Bermuda grass, nut sedge, mugwort, Johnson grass, Quack grass, Canada Thistle or noxious weeds as set forth in the Federal Seed Act. It shall be certified free of Southern Blight.

28.20.1 Notify the COTR of location of all sources of the topsoil and furnish a certified report from the agricultural experiment station or approved agricultural laboratory of an analysis performed not more than 60 days prior to the date of submission. If the topsoil is a mix, it shall be mixed off-site. The topsoil shall be certified to meet the following requirements:

a. Shall be a natural, original surface soil of a sandy loam texture with a mechanical analysis of 60-65% sand, 15-25% silt and 10-15% clay.

b. Shall have at least 2%, but not more than 5%, organic matter.

c. Soil pH shall be 5.5 to pH 6.5 inclusive unless otherwise specified.

d. Soil salinity by electrical conductivity measurement shall not exceed 600 parts per million (ppm) as determined by Black, Editor "Method of Soil Analysis," Part 2, published by the American Society of Agronomy, 1965.

e. The soil nutrient level shall be greater than 100 lbs./acre of magnesium, 150 lbs./acre of phosphorous and 120 lbs./acre of potassium.

28.20.2. Agricultural limestone at not more than 5 pounds per cubic yard of top soil may be used to adjust an acidic condition provided it is well mixed in a manner, which does not destroy the structure of the soil.

28.20.3. Topsoil that has been synthesized by blending materials which individually do not meet the requirements of this specification will not be accepted even though the resulting blend meets the organic matter, mechanical analysis, pH and soluble salts requirements.

28.20.4. The COTR reserves the right to inspect and sample all topsoil at the source and at the time of delivery. These inspections will be made without cost to the Contractor.

28.20.5. Topsoil must not be delivered or handled in a frozen or muddy condition.

28.20.6. Shipment and Delivery - All soil must be approved by the COTR before delivery to the site. Any material not meeting requirements of this specification will be rejected on or after delivery.

28.21. SCREENED LEAF MOLD

As available through Maryland Environmental Services, 2020 Industrial Drive, Annapolis, MD 21401 (301/261-8596) or approved equal, completely composted and free from all materials such as glass, paper, plastics, etc. Composted sewage sludge shall not be used.

28.22. SOIL MIX AGGREGATE

Aggregate shall be Solite 3/8 inch as manufactured by Solite Corp., 2508 Chamberlain Avenue, Richmond, VA or approved equal. Lightweight aggregate shall be expanded shale or slate expanded by the rotary kiln process. The aggregate shall meet the requirements of the American Society of Testing Materials C331-81 and C33-80.

28.23. BACKFILL

28.23.1 When existing soil is acceptable for use: Existing topsoil shall be used unless so directed otherwise by the COTR. The following mixture in accordance with the specifications herein, thoroughly mixed by volume shall be sued as backfill:

6 parts existing soil
2 parts leaf mold
2 parts Solite #388

28.23.2. When existing soil is not acceptable for use: If so determined by the COTR that the existing soil is not acceptable for use, the Contractor shall excavate all soil to a depth of 24 inches and disposed of off-site. The following backfill mixture, thoroughly mixed by volume in accordance with the specifications herein, shall replace the excavated soil:

60% sandy loam topsoil
20% Solite #388
20% Composted leaf mold

28.23.3. Backfill shall be mixed off site. If requested, backfill shall be mixed in the presence of the COTR. Backfill must be approved by the COTR before delivery to the job site.

28.24. GROUND LIMESTONE

Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80% calcium carbonate equivalent with a minimum 99% passing a No. 8 (2.36 mm) sieve and a minimum 75% passing a No. 60 (250 micrometer) sieve.

28.24.1. Provide lime in the form of dolomitic limestone.

29. DEBRIS CONTROL AND DAILY CLEANUP

29.1. Regularly clean up the work areas and at all times, maintain the project in as neat and orderly a manner as is consistent with normal operations. Debris resulting from construction operations shall be removed from the site daily by the Contractor. The Contractor shall keep all access, haul routes and site areas free of dirt, debris and other materials resulting from construction activities.

29.2. Under no circumstances shall any rubbish or waste be dropped or thrown from one level of scaffolding to another or within or outside the building. Rubbish may be lowered by way of chutes, taken down on hoists or lowered in receptacles.

29.3. In addition to a general daily clean-up and removal of rubbish, the Contractor shall immediately prior to final inspection for completion and acceptance, or when directed by the COTR, have all surfaces swept and dusted, and all finished surfaces washed and in a new appearing condition with all stains, soil marks, dirt and other forms of defacement removed.

29.4. Trash receptacles: provide enclosed trash receptacle(s) in quantity and size necessary to meet project needs, located as approved by the COTR. Trash receptacles shall not be placed out of public viewing.

29.5. Refer to -Construction Waste Demolition Waste Tracking Sheet, following section 010000. Recycle, salvage or otherwise divert from landfills and incinerators, at least 50%, with a goal of at least 75%, by weight (tons), unless otherwise noted, of non-hazardous construction and demolition material. Track recycling efforts and diversion rates using the Construction and Demolition Waste Tracking Sheet, attached. Before any work is started, submit a Construction Waste Management Plan, consisting of waste identification and a waste reduction work plan. Waste identification shall indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Include estimated quantities and assumptions for estimates. Waste reduction work plan shall list each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures. With each application for payment, the Contractor shall submit the Construction and Demolition Waste Tracking Sheet, attached, with data compiled for the payment period, including receipts from hauler or destination. Before request for substantial completion, Submit calculated end-of-Project percentage of waste diverted from landfills and incinerators (recycled, salvaged, or disposed) as a percentage of total waste generated by the Work. With request for final payment, the Contractor shall submit actual percentage of waste diverted from landfills and incinerators (recycled, salvaged, or disposed) as a percentage of total waste generated by the Work.

29.6. All food and food wrappings brought on the premises must be properly disposed of in approved containers that are secured from animals and pests.

30. DUST AND AIR QUALITY CONTROL

30.1. The Contractor will execute the Work by methods that minimize dust, vapors and gases raised by construction operations. The Contractor will utilize engineering controls and work practices to prevent airborne dust, vapors, gases and objectionable odors from dispersing into the atmosphere and from being drawn into existing air-intake louvers, ductwork, and adjacent elevator shafts. A work plan of methods and means for this section shall be submitted to the COTR for review and approval.

30.2. Dust barriers shall be erected, where necessary, to protect adjacent areas from dust infiltration as required by the COTR. Dust barriers shall be rigid and visually opaque and shall seal the work area by affixing to the structure on all sides (i.e. ceiling, walls and floor). Wood used for dust barriers shall be pressure-impregnated, fire-retardant treated lumber. All plastic sheeting shall be fire-retardant 6-mil polyethylene. Submit product data for review and approval to the COTR.

30.3. Means of connection of dust barriers to existing structures shall not damage the building fabric. Details of barriers shall be submitted for approval to the COTR.

30.4. No open fires or burning of trash are permitted.

31. NOISE CONTROL

31.1. Comply with the regulations of the District of Columbia and OSHA Standards 1926.52 and 1910.95 and all other regulations relative to safety noise control.

31.2. Activities that generate excessive noise or vibration and interrupt NZP functions or create public disturbances may be required to be performed during off-hours at the discretion of the COTR.

31.3. The Contractor shall provide sound attenuation to maintain acoustic level below 75 dBA at a distance of 50 feet or below 75 dBA in occupied staff areas if less than 50 feet away from noise source.

32. VERMIN, PEST AND RODENT CONTROL

32.1. Use non-chemical means and practices that deter or prevent the introduction of pests into the project site or premises. No chemical means shall be permitted. Contractor's focus should be NO FOOD DEBRIS on site with mandatory daily cleanup and removal.

33. DRILLING, WELDING TORCH CUTTING AND OTHER OPERATIONS THAT PRODUCE AIRBORNE CONTAMINANTS

33.1. Daily Permits:
When welding, torch cutting or other heating operations are to occur inside existing structures, the Contractor shall obtain a daily HOT WORK PERMIT.
During the course of the Work, all existing smoke and heat detectors and sprinklers heads must remain operable. Coverings may be applied to protect them from spray coatings or other hazardous conditions only during the actual operations. Coverings must be removed immediately after the operations have concluded, but at the end of each working day at a minimum. When work produces dust or other airborne contaminants, e.g. spray painting, that could impair existing fire suppression or detection system(s) or when the system itself is otherwise impaired (drained down, etc.), Obtain a daily FIRE SYSTEM IMPAIRMENT PERMIT.
Each permit must be obtained at least two working days in advance from the COTR and posted at the job site prior to beginning the scheduled work.

33.2. Fire Watch: No welding or torch cutting shall be performed unless adequate fire protection is provided. Maintain a fire watch for the duration of welding, cutting and heating operations and for at least 30 minutes after the 'hot' work has stopped. A fire extinguisher (minimum 10 pounds, dry-chemical type, typical) shall be on hand when drilling, welding or cutting.

33.3. Use of Impact Hammers: The use of impact hammers or other equipment causing vibration, noise and dust may be harmful to collection animals and/or building occupants Request approval from the COTR at least five (5) working days before beginning this type of work to ensure adequate time for notification of building occupants and protection of objects and collections.

33.4 Ventilation: Provide adequate ventilation to prevent air contamination or the accumulation of toxic materials. Take necessary measures to prevent welding fumes from entering mechanical ventilation systems, or passive transfer to adjacent areas. Seal all adjacent ducts and equipment openings with plastic. Where transfer is deemed likely or verified by the COTR, utilize local exhaust ventilation with HEPA filtration to control welding fumes. Submit means and methods for controlling air contamination to the COTR for review and approval.

TEMPORARY CONSTRUCTION FACILITIES

34. CONTRACTOR FIELD OFFICES, TRAILERS AND SHEDS

34.1. Establish a temporary office at the project site. Provide information about proposed locations of any temporary office, sheds, trailers and staging and storage areas and designation of size, color and materials to the COTR for approval at least five (5) working days prior to mobilization.

34.2. The Contractor may provide his own locking device on the door to the temporary office, trailer or shed. The Contractor shall be solely responsible for the safekeeping and security of the construction facilities, materials and equipment.

34.3. Upon completion of the Work, the temporary offices, trailers and sheds shall be removed and the area returned to its original pre-contract condition.

35. STAGING, STORAGE AND WORK AREAS

35.1. Staging and Storage Areas: Coordinate with the COTR the use of any area proposed for staging and storage of materials and equipment at least five working days prior to mobilization or at the Preconstruction Meeting, whichever is first.

35.2. Provide adequate storage and protection of materials and equipment delivered to the site to prevent theft, weather damage, mold infiltration, moisture damage and other physical damage. . The site shall be maintained in a neat and orderly manner as to further minimize hazards to personnel, animals, visitors, materials and equipment.

35.3. Plan for Staging, Storage& Work Areas: Submit a drawing of areas proposed for construction operations for approval by the COTR at least five (5) working days prior to mobilization or at the Preconstruction Meeting, whichever is first. The drawing shall show buildings, utilities, temporary toilet facilities, temporary utility extensions, temporary interior walls and barriers to limit unauthorized intrusion and to control noise and dust, pedestrian walkways, vehicular access, temporary fencing, trailers, sheds, storage areas and the Contract's desired route for access and egress to the premises and to the project site.

35.4. All wood used for temporary, interior construction shall be pressure-impregnated with a "Dricon" treatment or an equal treatment approved by the Smithsonian Institution. All pieces must bear the UL "FR-S" stamp. Intumescent (fire-retardant) paint shall not be used. All plastic sheeting shall be fire retardant 6-mil polyethylene. Submit product data to the COTR for review and approval.

35.5. Interior Protection Barrier: Provide floor to ceiling heavy-duty plastic secured at all edges to create a tight seal between areas of work and areas occupied by collection animals or staff. Include full zip doors or overlapped layers of plastic for staff to move through that create an airtight barrier when closed.

35.6 Temporary Chain Link Fencing with Lockable Gates shall isolate the public, SI staff and collection animals in accordance with the Contract plans and technical specifications. In the event that all the work area locations are not specifically indicated within the Contract Documents, the Contractor shall identify and implement a safe isolation barrier. All fence sections will be maintained in a new or like new condition. Damaged sections will be removed from site.

35.6.1. FENCE TYPE 1 - Temporary Chain Link Fencing**:** Provide and maintain a 6’ 0” tall by 7’ 0’ wide steel pipe framed fence with 2” x 2” galvanized steel fabric barrier surrounding the construction site and or work zones. Provide panel support bracing - 1-3/8" Pipe 7' L with (2) bends and bases to add extra support to chain-link panels as required to ensure fences is stabilized from in order for the fencing to withstand anticipated winds while remaining upright.

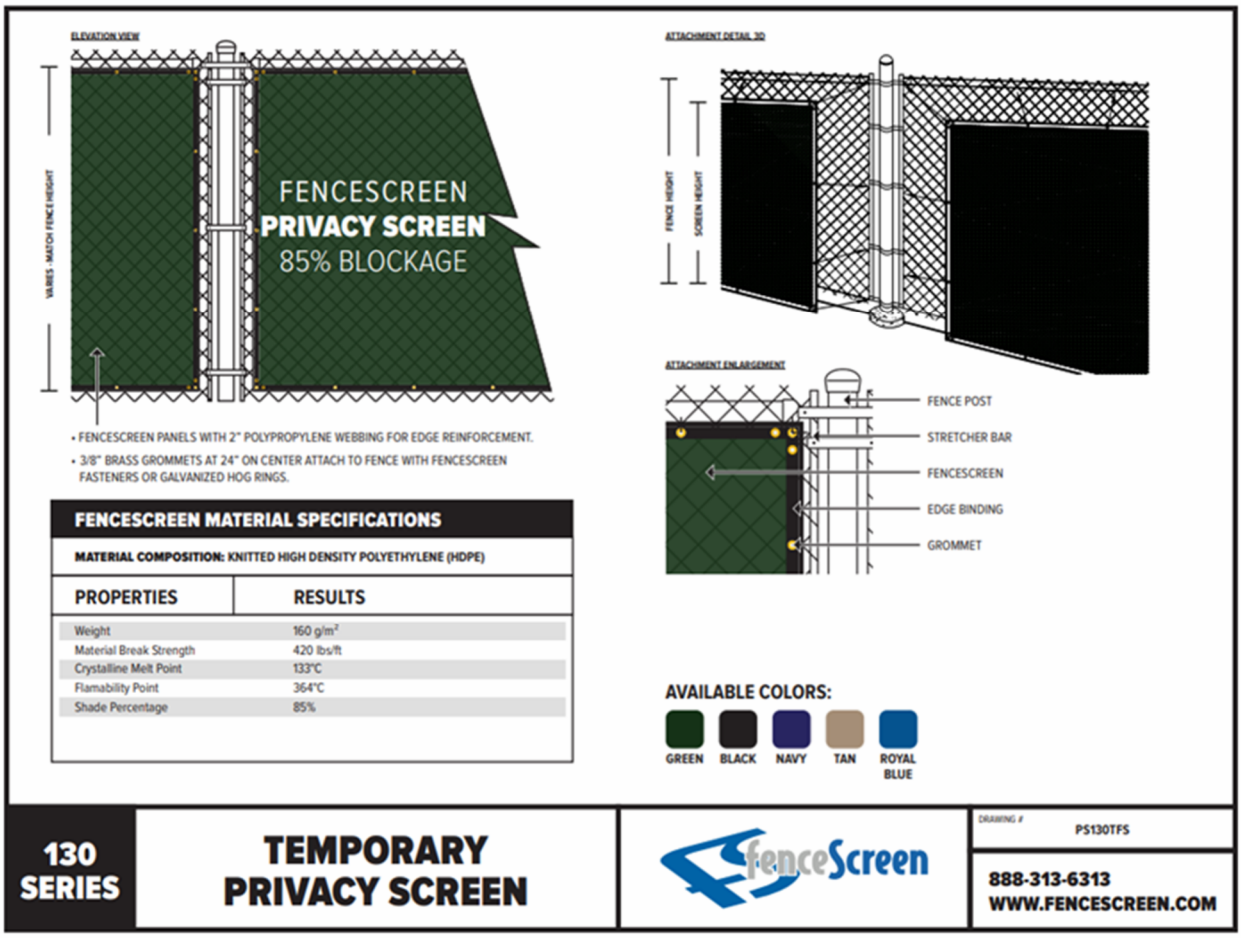
35.6.1.1 BASE TYPE A - Two Hole Concrete Surface Placed Base

35.6.1.2 BASE TYPE B **-** Temporary Post Stands: Hi-Viz Anchor Stand Temporary Fence Base to Prevent stubs, trips, and other accidents with a high-visibility temporary fence base when placed on or near walking surfaces.

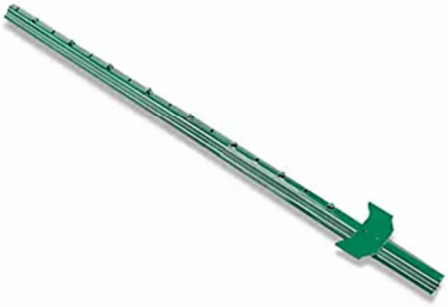
35.6.1.2 **BASE TYPE C** - Post Mounted in core drilled holes 2’ into pavement, asphalt, pavers, brick or driven into earth. Patch holes at end of construction with similar materials.

35.6.2 Sectional Privacy Screen- only if indicated

- Color Green
- Brass Grommets
- One Screen Section per One Fence Section
- Attached with UV Outdoor Fence Fasteners
- Or Equal to the information provided below


ELEVATION VIEW
VARIES - MATCH FENCE HEIGHT
FENCESCREEN
PRIVACY SCREEN
85% BLOCKAGE
• FENCESCREEN PANELS WITH 2" POLYPROPYLENE WEBBING FOR EDGE REINFORCEMENT.
• 3/8" BRASS GROMMETS AT 24" ON CENTER ATTACH TO FENCE WITH FENCESCREEN FASTENERS OR GALVANIZED HOG RINGS.
FENCESCREEN MATERIAL SPECIFICATIONS
MATERIAL COMPOSITION: KNITTED HIGH DENSITY POLYETHYLENE (HDPE)
PROPERTIES
RESULTS
Weight
160 g/m²
Material Break Strength
420 lbs/ft
Crystalline Melt Point
133°C
Flamability Point
364°C
Shade Percentage
85%
ATTACHMENT DETAIL 3D
FENCE HEIGHT
SCREEN HEIGHT
ATTACHMENT ENLARGEMENT
FENCE POST
STRETCHER BAR
FENCESCREEN
EDGE BINDING
GROMMET
AVAILABLE COLORS:
GREEN
BLACK
NAVY
TAN
ROYAL BLUE
130 SERIES
TEMPORARY PRIVACY SCREEN
FenceScreen
DRAWING #
PS130TFS
888-313-6313
WWW.FENCESCREEN.COM

Safety Fence Post - Standard, 6'



More Images

Control pedestrian and vehicle traffic around temporary hazards.

- Recommended for construction sites, parking lots or warehouses.
- Sturdy painted steel for in-ground use. Ground anchor plate for stability.
- Metal tabs hold fencing in place.
- Use with 4 ft. Standard and Heavy Duty Safety Fences.
- Install into ground with Post Driver.

MODEL NO.	DESCRIPTION	SIZE	FOR USE WITH	WT. (LBS.)	PRICE EACH (MIN. 3)			IN STOCK SHIPS TODAY
					3	12	24+	
H-4637	Standard	6'	4' Tall Fence	3	$13	$12	$11	3 ADD

Additional Info | Shopping Lists | Request a Catalog

DIMENSIONS:
- Width: 1 1/4"

THICKNESS:
- 14 gauge

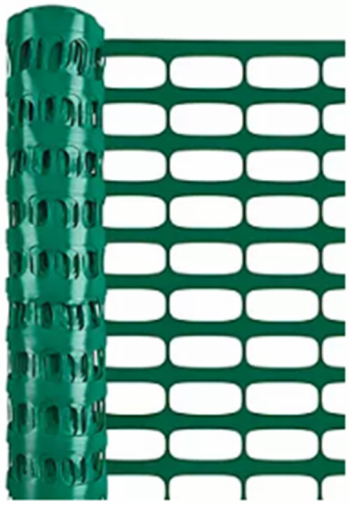
USAGE:
- Post needs to be 2' into the ground to be stable.
- Posts should be 8 to 10' apart with Safety Fences for maximum efficiency.

Availability: In Stock
Unit Weight: 3 lbs.

Email Item

Country of Origin: USA

Safety Fence - Heavy Duty, 4 x 100', Green



Enlarge

Control pedestrian and vehicle traffic around temporary hazards.

- Recommended for construction sites, parking lots or warehouses.
- Easy to install and remove. Rolls up for easy transport.
- 50% stronger for windy, snowy winter conditions.
- Safety Fence Post sold separately.

SPECIFY COLOR:

MODEL NO.	DESCRIPTION	SIZE H x L	THICKNESS (MIL)	WEIGHT (LBS.)	PRICE EACH 1	PRICE EACH 3	PRICE EACH 12+	COLOR	IN STOCK SHIPS TODAY
S-22226G	Heavy Duty	4 x 100'	20	13	$50	$49	$48	Green	1 ADD

Additional Info | Shopping Lists | Request a Catalog

DIMENSIONS:
- Mesh: 1.8 x 3.3"

MATERIAL:
- Polyethylene/Polypropylene

PROPERTIES:
- Tensile Strength: 17 lbs per inch

RECYCLING:
- Not recyclable

Availability: In Stock
Unit Weight: 14 lbs.

Catalog Page 737

Email Item

Country of Origin: USA

36. SANITARY/TOILET FACILITIES

36.1. Contractors' personnel will be permitted to use designated the public restrooms located on the premises, subject to the regulations and control of the COTR. If, in the opinion of the COTR, the Contractors' personnel fail to maintain acceptable dress and conduct appropriate to a public place, permission to use the public restrooms may be rescinded.

37. TEMPORARY UTILITY SERVICES AND EXTENSIONS

37.1. Existing electrical, and water utilities are available for the Contractor's use as designated by the COTR.

38. SCAFFOLDING AND PLATFORMS

38.1. Erect temporary scaffolding in accordance with OSHA 29 CFR 1926.451 and ANSI A10.8. Provide landing platforms with stairways or ladders for proper access and egress to all work areas.

38.2. For all frame scaffolding greater than thirteen feet in height submit working drawings to the COTR a minimum of ten (10) working days in advance of scaffolding erection. Working drawings submitted by the Contractor shall be certified by a registered Professional Engineer. Provide additional safety plan and training certifications for any motorized scaffolding or lifts. Provide weight and size of any proposed motorized lifts for approval.

38.3. During non-working hours, close and lock the scaffolding/lifts with a physical barrier to prevent access by unauthorized persons.

39. PROJECT SIGNS [NOT USED]

MEETINGS

40. PRECONSTRUCTION MEETING

40.1. A Preconstruction Meeting will be scheduled with the Contractor before any work is started at the site. As soon as possible after the Date of Award, the COTR will contact the Contractor to arrange a time, date and place for the conference. Items to be discussed at the Preconstruction Meeting include, but are not limited to:

- 40.1.1. Contract Time: Notice to Proceed date and Completion date;
- 40.1.2. Scheduling and Submittals;
  - 40.1.2.1. Progress Schedule
  - 40.1.2.2. Payment Breakdown Schedule
  - 40.1.2.3. Required Submittals
- 40.1.3. Mobilization and Staging – Area for Materials and Equipment;
- 40.1.4. Access to the Premises, Haul Routes, Loading Dock;

40.1.5. Contractor Deliveries;

40.1.6. Security Requirements/List of Contractor's Personnel;

40.1.7. Emergency Procedures and Phone Numbers;

40.1.8. Protection of Site and Premises;

40.1.9. Fire Protection, Safety and Health Requirements;

40.1.10. Utility Interruptions, Rough-in Inspections, Testing;

40.1.11. Applications for Payment;

40.1.12. Pre-Condition Survey of the Site;

40.1.13. Accessibility Requirements;

40.1.14. Sequence of Construction;

40.1.15. Quality Assurance and Inspection of the Contract Work;

40.1.16. Sustainability Requirements;

40.1.17. Building Systems Commissioning;

40.1.18. Quality Control;

40.1.19. Preservation of Wildlife and Natural Resources.

40.2. All of the Contractor's staff and Subcontractors or Suppliers whose presence is necessary or requested by the COTR shall attend the Preconstruction Meeting.

40.3. Coordination Plan: Use the Preconstruction Meeting to develop a Coordination Plan for interaction with other parties working in or using the facility. The plan shall be submitted no less than five (5) working days after the Preconstruction Meeting and shall address interactions with other contractors, tenants, the public and any others making use of the site and surrounding areas. As a minimum it shall include:

40.3.1. Locations of overlap in use of the site by the Contractor and others, including work areas, delivery points, access/egress areas.

40.3.2. Specific items of work by others required to support critical milestones in the Contractor's schedule.

40.3.3. Completion or delivery of work by others that may impact the Contractor's schedule.

40.3.4. Portions of the work that create special hazards or disturbances.

40.3.5. Portions of the work that affect utilities, fire-protection or detection systems or security systems.

40.3.6. Events requiring access to areas outside of the project site or secured spaces.

40.3.7. Protection to be provided by the Contractor for work completed by others either before or during this project.

41. PRE-CONDITION SURVEY OF THE SITE

41.1. After the Preconstruction Meeting and before the start of work on the site, the project site (i.e. building, yards, contents, grounds and equipment) shall be inspected by the Contractor, major Subcontractors, COTR and other Smithsonian Institution and NZP personnel as may be required for the purpose of verification of the existing conditions. Any damages or defective equipment will be noted at this time and this survey will serve as the basis for the establishment of the pre-contract conditions. The identification of pre-contract conditions will be jointly established by the Contractor and Smithsonian Institution.

4.1.2. Any damage to the buildings, yards, their contents, grounds, or equipment that occurs during the Contract period, unless noted as existing during the inspection as specified above shall be repaired to its pre-contract condition by the Contractor at no cost to the Smithsonian or National Zoological Park. The COTR will determine the adequacy of the repairs as required in the previous paragraph.

41.3. Written and photographic documentation: Prepare a typewritten and photographic report in PDF format to identify damages or defects of materials, equipment and the site. Submit the report electronically to the Contracting Officer and the COTR.

42. PROJECT MEETINGS

42.1. Progress Meetings: The COTR will lead regular progress meetings with an interdisciplinary integrated management team consisting of representatives (as required) of the Contractor, Smithsonian, Architect/Engineer, major Subcontractors and other critical Subcontractors and suppliers. The purposes of these meetings are to expedite the work, coordinate and schedule the Work and coordinate the work with Smithsonian activities. Progress meetings shall be held weekly unless otherwise directed by the COTR. The time and place of the meetings will be established at the Preconstruction Meeting. Ensure that all required Subcontractors and suppliers attend the Progress Meetings and the COTR will ensure that all necessary SI personnel attend.

42.2. Special-Topic Meetings: At the discretion of the COTR, additional separate meetings may be scheduled to address issues of quality control, sustainability requirements, coordination between contractors on the premises, coordination with other agencies, scheduling of the work, application for payments, etc. The Contractor's staff and Subcontractors or Suppliers whose presence is necessary or requested by the COTR shall attend.

42.3. Meeting Minutes: Promptly prepare minutes of each meeting and transmit to the COTR, within five (5) working days.

SUBMISSIONS

43. SUBMITTAL DEFINITIONS

43.1. Submittals are defined to include shop drawings, product data, samples and additional data required for submission to the COTR for review and approval prior to incorporation into the work.

43.1.1. Shop Drawings: Detailed drawings, schedules, diagrams and illustrations prepared specifically for this project by the Contractor or any subcontractor, manufacturer, supplier or distributor to illustrate fabrication and/or installation of a portion of the Work.

43.1.2. Schedule: A detailed tabulation of components, items or parts to be furnished for use on this project.

43.1.3. Statement: An affirmation prepared by the Contractor, the installer or manufacturer of a material, product or system, to satisfy a requirement defined in a technical section.

43.1.4. Factory Test Report: A written report of the findings of a test performed by the Contractor on an actual portion of the Work or prototype prepared for this project before it is shipped to the site.

43.1.5. Field Test Report: A written report of the findings of a test performed by the Contractor on a portion of the Work during or after installation.

43.1.6. Certificate of Compliance: A written statement, signed by an authorized official of the manufacturer of a product or system or supplier of a material attesting that the product, system or material meets the requirements of the contract documents. The certificate of compliance must be dated after the award of this Contract and must name the project and cite the specification section, paragraph and requirements, which it is intended to address.

43.1.7. Product Data: Illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature and catalog information illustrating a material, product or system to be installed on this project, including all data related to LEED requirements, such as recycled and regional content information, Volatile Organic Compound (VOC) product schedules, Forest Stewardship Council (FSC) chain-of-custody documentation and other documentation as requested by the COTR.

43.1.8. Color Charts: Pre-printed brochures showing the color range of a material.

43.1.9. Test Reports: Reports verifying that a material, assembly, system, process or laboratory meets requirements established in the Contract Documents. Reports shall indicate compliance by naming and describing the test method and test results. Testing must have occurred within three (3) years of the date of award of this contract.

43.1.10. Samples: Physical examples of materials, equipment, assemblies or workmanship establishing standards for evaluating finished Work.

43.1.11. Color/Texture Selection Sample: Samples of an available range of textures and/or colors of a material formed of the actual finish material over a substrate identical to that which will be used in the field.

43.1.12. Mock-up: An assembly or sample panel constructed in accordance with specifications to show construction details, finished appearance and/or performance.

43.1.13. Material Safety Data Sheets: Instructions, warnings and recommended and required handling and use procedures for individual hazardous materials published by the product manufacturer.

44. SUBMITTALS AND REVIEWS

44.1. Contractor Responsibility for Submittals: Provide all required submittals, by technical specification section, in accordance with the Contract Documents. All submittals, with exception of mockups or samples, are to be submitted electronically by email in PDF format. Clearly indicate on the submittal that it has been reviewed by the Contractor and found to meet the project requirements. Any items submitted as substitutions shall be clearly identified as such on the submittal and the transmittal document. If shop drawings show variations from the Contract Documents because of standard shop practices or for other reasons, provide a separate, written description of variations along with the submittal. The Contractor shall:

44.1.1. Review each submittal for conformance with requirements of the contract documents and coordination with related work.

44.1.2. Determine and verify all field measurements, required material quantities, method of assembly or erection, installation requirements and proper connection to adjoining materials installed by others.

44.1.3. Assure that all submittals use the appropriate units of measure. All drawings and technical data shall be in Imperial units

44.1.4. Transmit all required submittals for a technical specification section at the same time unless prior written waiver of this requirement has been provided by the COTR.

44.1.5. Transmit submittals to the COTR in a logical and orderly sequence in accordance with the Submittal Schedule to prevent project delays or adversely impact work by the Smithsonian Institution or other contractors.

44.1.6. Correct and resubmit submittals according to response from Smithsonian Office of Engineering Design & Construction through the COTR.

44.1.7. Commence work on items requiring submittals only after all related submittals are reviewed and approved by the Smithsonian. All Work shall conform to approved submittals.

44.2. Submittal Schedule and Control Log: The Contractor shall submit, to the COTR, a schedule of work-related submittals using the Smithsonian SF Submittal Log form within *fourteen (14) calendar days after the effective date of the Notice to Proceed. (An electronic Submittal Log form is available upon request.) Submittals shall be listed in the order they are scheduled to be submitted and the following information shall be given:

44.2.1. Project Name, Project Number, Contractor Name, Contract Number;

44.2.2. Technical Specification Section for each submittal;

44.2.3. Unique Submittal Number;

44.2.4. Description of item to be submitted, as listed in the specifications;

44.2.5. Date item must be submitted to the Smithsonian in order to support the project schedule;

44.2.6. Subcontractor providing submittal (in "Comments" column).

44.3. Quantities for Submittals: Unless otherwise noted in the technical specification, the Contractor shall deliver to the COTR:

44.3.1. Shop Drawings: Submit electronic copy of shop drawings in PDF format. Submittal will be forwarded electronically to the AE for review. After submittal review, submittal will be returned to the Contractor electronically, in PDF format. Also submit in DWG format. Submit two reproducible black line prints, if requested.

44.3.2. Product Data, Test Reports, Color Charts, etc. Make electronic submittals in PDF format, except for Color Charts. Submit two (2) original Color Charts from each product representative to be retained by the Smithsonian; copies or printouts from the computer will not be accepted. After submittal review, submittal will be returned to the Contractor electronically, in PDF format.

44.3.3. Color/Texture Samples: Submit two (2) samples, minimum size two feet by 2 feet. After submittal review, one (1) sample may be retained by the Smithsonian.

44.3.4. Mock-up and Sample Installations: Unless otherwise specified, minimum size shall be as noted to complete a panel section or normal break in the work.

44.3.5. Written Text Documents, Plans and Reports: Submit electronic copy of written text documents, plans and reports in PDF format. Submittal will be forwarded electronically to the AE for review. After submittal review, submittal will be returned to the Contractor electronically, in PDF format.

44.4. Submittal Reviews by the Smithsonian: Reviewed submittals will be marked "Approved," "Approved as Noted," "Resubmit" or "Disapproved." Submittal approval by the Smithsonian shall not relieve the Contractor of responsibility for submittal errors, omissions or

deviations from the contract documents. Approval of submissions does not constitute acceptance of substitutions except as covered under sub-paragraph entitled "Contract Requests for Substitutions."

44.5. Submittal Review Period: Transmit, to the COTR, all submittals sufficiently in advance of the time necessary for fabrication and installation to allow for review by the Smithsonian and return to the Contractor, including any time needed for correction and resubmission by the Contractor. The expected time required by the Smithsonian for review of initial submission is 14 calendar days. No extension of the Contract Time will be granted for the Contractor's failure to allow sufficient time for review and processing, including resubmission of items that are initially rejected due to improper submission or non-compliance with the Contract Documents.

44.6. Contractor Requests for Substitutions: Contractor requests for items identified by manufacturer, brand name, make, catalog number, etc. in the Contract Documents shall be submitted to the Contracting Officer for approval prior to Contract award, in accordance with the General Conditions. After award of the Contract, Contractor requests for substitutions may be considered and accepted by the Smithsonian at the discretion of the Contracting Officer.

44.7. Construction Progress Schedule Submittal: Submit a progress schedule within one (1) calendar day from the date of the Notice to Proceed. No work shall start at the site until the progress schedule has been approved by the COTR. The schedule shall provide a weekly breakdown of activity including interaction between trades and be subdivided in accordance with items of work or areas of the job where the work is to take place. The schedule shall also list equipment, special devices, hardware, products or other items requiring long lead time, when these items are ordered and the projected delivery dates. The last week of the schedule shall reflect final inspection, testing, and the correction of deficiencies.

45. CRITERIA FOR PRODUCT SELECTION

45.1. To the greatest extent possible, subject to the restrictions of the Buy American Act, provide products, materials or equipment of a singular generic kind from a single source. Where more than one choice of a product or material is available for Contractor's selection, select an option, which is compatible with other products and materials already selected.

45.2. Provide products complete with accessories, trim, finish, safety guards and other devices and details needed for complete installation for intended use and effect.

45.3. Products, which, by nature of their application, are likely to be needed at a later date for maintenance and repair or replacement work, shall be current models for which replacement parts are available.

45.4. Product selection shall be done in accordance with the following requirements:

45.4.1. Standards, Codes and Regulations: Select from among products that are in compliance with the project requirements, as well as with construction standards, all applicable codes and regulations and LEED requirements.

45.4.2. Performance Requirements: Provide products that comply with specific performances indicated and are recommended by the manufacturer (in published product literature or by individual certification) for the application indicated.

45.4.3. Prescriptive Requirements: Provide products that have been produced in accordance with prescriptive requirements, using specified ingredients and components and complying with specified requirements for mixing, fabricating, curing, finishing, testing and other operations in the manufacturing process.

45.4.4. Visual Matching: Where matching with an established sample for color, pattern and/or texture, the COTR shall determine whether a proposed product matches the sample.

45.4.5. Avoidance of banned materials: The Contractor will commit to not using the following toxic and hazardous materials:

45.4.5.1. Products containing asbestos, urea formaldehyde, polychlorinated biphenyls (PCBs) and/or chlorinated fluorocarbons;

45.4.5.2. Products containing lead content, including older or flux containing more than 0.2 percent lead; domestic water pipe or pipe fittings containing more than 8 percent lead; and paint containing more than 0.06 percent lead.

46. PROGRESS PHOTOS NOT USED]

47. CONTRACTOR CORRESPONDENCE AND DAILY REPORTS

47.1. Correspond with the COTR for all matters related to this construction project, unless otherwise directed. All correspondence shall be signed and dated by the Contractor and shall reference the project, project number and Contract number.

47.2. Maintain daily reports using the Smithsonian Institution Contractor's Daily Report form. Reports shall be numbered consecutively and all sections shall be completed or noted as "not applicable." Reports shall contain detailed remarks each day, including but not limited to progress on the job, problems discovered and discussions with Smithsonian staff. Reports shall be submitted to the COTR each day for the previous workday.

SAFETY, HEALTH AND FIRE PROTECTION

48. JOB SITE SAFETY

48.1. Safety Coordinator: The Contractor shall designate a person responsible and accountable for personnel safety at both corporate and project level at the project site for the duration of the project. Contracts specifically requiring safety or industrial hygiene personnel shall include a

copy of their resumes. Qualifications for the Safety Coordinator shall include the OSHA 30-hour course or equivalent course.

48.2. Job Site Safety Plan: The Contractor shall submit a Jobsite Safety Plan within 5 calendar days of the Contract Award and at least 5 calendar days prior to mobilization to the site for approval by the COTR. As a minimum, the plan shall detail the procedures, designated persons, instructions and reports to be used to assure jobsite safety for all Contractor's, subcontractors, Smithsonian personnel, the public and others on the site.

48.2.1. Site Specific Safety Plan (For Project value $100K and above): Upon award of this contract, the Contractor shall provide a Site-Specific Safety Plan (SSSP). The SSSP is a safety and health policy and program document and outlines how the Contractor will safely conduct their work. This plan shall be job-specific and shall also address any unusual or unique aspects of the project or activity for which it is written. The SSSP shall interface with the employer's overall safety and health program, and a copy shall be available on the work site. Any portions of the employer's overall safety and health program that is referenced in the SSSP shall be included as appropriate. The plan shall include but not limited to the following:

a. Signature Sheet that must include plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional, project QC). Provide concurrence of other applicable corporate and project personnel (Contractor).
b. Background Information that must include Brief project description, description of work to be performed, and location; phases of work anticipated these will require a Job Hazard Analysis (JHA's). OSHA 3071
c. Statement of Safety and Health Policy
d. Responsibilities and lines of Authority
e. Subcontractors and Suppliers
f. Training
g. Safety and Health inspections that include assignment of responsibilities for a minimum daily/weekly job site safety and health inspection during periods of work activity level of technical proficiency needed to perform the inspections, proof of inspector's training/ qualifications
h. Accident Reporting
i. Plans (programs, procedures) required by the Safety Manual. Based on a risk assessment of contracted activities and on mandatory OSHA compliance programs, the Contractor shall address all applicable occupational risks and compliance plans. Using the 29 CFR 1926 and/or current and accepted procedures in the EM 385-1-1 as a guide.
j. Risk Management Processes Detailed project-specific hazards and controls shall be provided by a Job Hazard Analysis for each major phase/activity of work, including but not limited to work involving confined space, fall protection, trenching/excavation, crane/rigging, steel erection, hot work, protection of the public, scaffolding, and other activities that involve high risk potential.

48.3. Occupational Safety and Health: This contract is subject to Title 29 of the Code of Federal Regulations, Part 1910 "Occupational Safety and Health Standards" and Part 1926 "Safety and Health Regulations for Construction" pursuant to the Occupational Safety and Health Act (OSHA) of 1970 administered by the US Department of Labor, Occupational Safety and Health Administration.

48.4. Emergency Assistance: Post, at the site, telephone numbers for reporting emergencies, including the NZP's Police Station, ambulance, police, fire department, gas utility, electric utility, water/sewer utility, poison prevention aid and hazardous-waste handling. This information shall be posted in a conspicuous location within the project area prior to the start of any work at the site.

48.5. Safety Signs: Post legible accident prevention signs in construction areas in accordance with OSHA standards. Safety signs shall conform to ANSI 235.1 and 235.2 Vehicular traffic control devices, barricades and signals shall conform to ANSI D6.1.

48.6. Report of Accident or Illness: In the event of any accident or illness for which medical assistance is required, any criminal action or any fire, the Contractor shall notify the appropriate authority (Ambulance, Police, and Fire Dept.), Smithsonian Security, NZP Police, and the COTR.

48.7. Emergency Evacuation: Post evacuation routes and facility emergency/self-protection plans at the site, train all employees in emergency procedures and document such training. In the event of a fire, the Contractor shall immediately activate the alarm at the nearest fire alarm pull station and notify building security. Upon the activation of the audible alarm, the building will be evacuated. No personnel shall reenter the facility until security personnel signal that the building is safe.

48.8. Contractor Personnel to be Contacted: Submit a written list of emergency telephone numbers and names of persons to contact for the General Contractor superintendent and for each major sub-contractor working on the project site. The initial list shall be submitted to the COTR at the Preconstruction Meeting. The list shall be updated and resubmitted to the COTR as needed.

49. TOXIC AND HAZARDOUS SUBSTANCES

49.1. Submit to the COTR for approval, at least ten (10) working days prior to their intended use, a written list of toxic and hazardous substances that will be used on the project. Submit a "Material Safety Data Sheet" similar to OSHA Form No. 20 for these substances to identify the following information:

49.1.1. Product Identification;

49.1.2. Hazardous Ingredients;

49.1.3. Physical Data;

49.1.4. Fire and Explosion Hazard Data;

49.1.5. Health Hazard Data;

49.1.6. Emergency and First Aid Procedures;

49.1.7. Reactivity Data;

49.1.8. Spill or Leak Procedures;

49.1.9. Special Protection Information;

49.1.10. Special Precautions;

49.1.11. Volatile Organic Compound (VOC) Content.

49.2. Commit to not using the following toxic and hazardous materials:

49.2.1. Products containing asbestos, urea formaldehyde, polychlorinated biphenyls (PCBs) and/or chlorinated fluorocarbons.

49.2.2. Products containing lead content, including solder or flux containing more than 0.2% lead; domestic water pipe or pipe fittings containing more than 8% lead; and paint containing more than 0.06% lead.

49.2.3. Chlorofluorocarbon (CFC)-based refrigerants in new base building heating, ventilating, air conditioning and refrigeration (HVAC&R) systems and comprehensive CFC phase-outs when reusing existing base building HVAC equipment.

49.2.4. The Contractor hereby understands that historic properties may contain pre-existing harmful materials and coatings including, but not limited to, arsenic, lead, dioxide, polyvinylchloride (PVC) and asbestos. Upon discovery of hazardous or toxic materials, the Contractor shall alert the COTR immediately.

49.3 Monitor the use of all toxic and hazardous substances to ensure that exposure to their workers from airborne concentration of, or physical contact with, these substances does not exceed applicable regulatory worker health and safety exposure limits.

49.4. Monitor the use of all toxic and hazardous substances to ensure that exposure to Smithsonian Institution and NZP employees and visitors to airborne concentrations of, or physical contact with, these substances is maintained as low as reasonably achievable. Any equipment or technical measures for this purpose must first be approved by the NZP's Safety Office through the COTR. Under no circumstances shall exposure exceed the established Short-Term Exposure Limit or 50% of the established Threshold Limit Values or Permissible Exposure Limits (whichever is less) as specified in either:

49.4.1. "Threshold Limit Values and Biological Exposure Indices" of the American Conference of Governmental Industrial Hygienists, latest revision, or

49.4.2. Title 29 CFR Part 1910, Subpart Z - "Toxic and Hazardous Substances" of the Occupational Safety and Health Standards, latest revision.

49.5. Exposure of the NZP's animals to air-borne or any other physical contact with any toxic or hazardous substance will be prohibited.

49.6. All toxic and hazardous substances and materials used by the Contractor must be removed from the NZP property upon completion of the project.

49.7. Provide methods, means and facilities to prevent contamination of soil, water and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations. The removal of contaminated waste shall be in compliance with applicable laws and regulations.

49.8. To achieve compliance with the requirements of this section, administration or engineering controls shall first be implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or other protective measures shall be used to keep exposure of all persons within the prescribed limits. Descriptions of equipment or technical measures to be used for this purpose must be submitted to the COTR for approval. The Contractor's requirements for compliance with all applicable Local, Federal and State regulations remain in force.

49.9. The SI may reject any product that poses a high risk of fire or health hazard to staff, visitors or the building, based on flammability criteria (e.g. low flashpoint) or established toxicity data (e.g. designation as a human carcinogen).

49.10. Submit, to the COTR, a list of the hazardous materials to be stored on site and the manner in which they will be stored. All containers and storage cabinets shall be approved by the COTR and labeled as to hazard and content.

49.11. The SI has made every effort to identify and to notify the Contractor of hazardous materials that may be encountered during the work. However, if suspected asbestos-containing material, lead-based paint or other suspected hazardous materials are encountered during demolition or other phases of the work, the work involving the suspected material shall cease and the Contractor shall notify the COTR immediately.

50. PERSONAL PROTECTIVE EQUIPMENT

50.1. Personal protective equipment for eyes, face, ears, nose, head, extremities and/or full body shall be provided, used and properly maintained by the Contractor whenever necessitated by reasons of hazards encountered in a manner capable of causing illness, injury or impairment in the function of any part of the body.

50.2. Persons required to use personal protective equipment shall be thoroughly trained. Training programs shall, as a minimum, meet OSHA and EPA requirements where applicable. Submit proof and criteria for employee training as requested.

51. BARRICADES, BARRIERS AND WALKWAYS

51.1. Provide safety barricades in accordance with the District of Columbia Building Code and applicable OSHA regulations. Also provide barricades, subject to approval by the COTR, to deter passage of persons and/or vehicles into construction areas as specified or necessary.

51.2. Install temporary barriers, in a manner satisfactory to the COTR, to contain and secure the site from unauthorized entry and to minimize the adverse effects of noise, dust and vapors

generated by construction activities on surrounding areas. Barriers shall be constructed of pressure-impregnated fire-retardant treated wood, with fire-retardant 6-mil polyethylene as necessary. Submit all product data to the COTR for review and approval.

51.3. If the work interferes with public or employee access to the facility or parts of the facility, as determined by the COTR, provide personnel barriers and signage to create easily identifiable, accessible (to people with handicaps) walkways around the work. Signs shall be posted at decision points to prevent unnecessary travel along changed routes and to dead ends. The barriers shall be erected and dismantled in phases so that a clear route is always available. The COTR and Contractor personnel shall have access through the barriers to the work areas. The Contractor may use hardware on the barrier doors to prevent entry by unauthorized persons.

51.3.1. Interior barriers shall be of standard drywall partition construction, painted and terminated at the underside of the existing ceilings. All requirements for fire protection shall be maintained.

51.3.2. Exterior barriers shall be of dimensional lumber and plywood, painted on both sides and supported to prevent overturning. Barriers shall be repainted and maintained as necessary to remain in good condition as long as they are required.

51.4. Unless specifically indicated otherwise, barricades, barriers and associated signs shall be removed upon completion of the Work. The Contractor shall coordinate the dismantling and removal with the COTR.

52. EXISTING FIRE PROTECTION SYSTEMS

52.1. During the course of the Work, all existing smoke and heat detectors and sprinkler heads must remain operable. Coverings may be applied to protect them from spray coatings or other hazardous conditions only during the actual operations. Coverings must be removed immediately after the operations have concluded. Damaged detectors and sprinkler heads shall be replaced immediately by the Contractor at no additional cost to the Smithsonian Institution. Test replaced detectors and sprinklers after installation to the satisfaction of the COTR.

53. GENERAL SECURITY REQUIREMENTS

53.1 The Contractor and his/her employees must comply with security requirements imposed by the National Zoological Park, including any necessary security clearances. Failure to inspect the site or obtain knowledge of security regulations shall not relieve the Contractor from security requirements or from performance of any part of the work.

53.2. Prior to the start of work on the site, the Contractor, after receiving the Notice to Proceed, shall submit to the COTR for approval, a list of the names, social security numbers, and addresses of all employees and subcontractor employees who will be working on the site. The list shall identify the Prime Contractor and each subcontractor and trade. It shall be updated as necessary to accurately identify all workers who will be working on the site during the project.

53.3. The name and telephone number of the Contractor's Superintendent and authorized alternate individual who can be reached on a 24-hour basis shall be provided to the COTR at the Preconstruction Meeting.

53.4 If the Contractor is required to accelerate the work in order to complete the project on schedule, or if other conditions arise as the result of Contractor's management of the work which required that work be accomplished during other than normal operating hours, the Contractor will be required to assume the cost of any additional inspection and guard services at overtime rates.

53.5. Notify the COTR prior to disturbing any alarm wiring, devices, systems, etc. Planned disturbances will be coordinated at least three (3) working days in advance of when the work is scheduled. Any alarm wiring, devices or systems that are disturbed for any reason must be reported to the COTR within five (5) minutes of the occurrence. The COTR will determine the procedures for repairing the damage and who will perform the repair work. The cost of such repairs will be borne by the Contractor.

53.6 Provide adequate security to prevent the presence of unauthorized persons on the work site area, and to keep doors secured when not in actual use to insure the integrity of the barrier as well as for the property security.

53.7. The Contractor is prohibited from hunting, collecting, or feeding animals on Smithsonian property.

53.8. The Contractor is prohibited from feeding, petting or harassing any NZP animal(s).

54. IDENTIFICATION BADGES [NOT USED]

55. [NOT USED]

56. SECURITY OF TEMPORARY OPENINGS

56.1. Any temporary opening in the building perimeter or between non-public and public interior spaces must be closed and secured with means acceptable to the COTR at the end of each workday. A clear and safe path shall be maintained at all times to allow visitors entrance into the National Zoological Park and its buildings. The Contractor shall secure his facilities and equipment during non-working times at his own expense. Authorized Smithsonian personnel shall have access to the work site.

57. EXISTING BUILDING ALARM SYSTEMS [NOT USED]

58. NZP POLICE OFFICER DUTY CHARGES

58.1. If the Contractor is required to accelerate the work in order to complete the project within the specified Contract Time or if other conditions arise as a result of the Contractor's management of the work, which require that construction be accomplished during other than the normal workdays and hours defined for this project, the Contractor will be required to assume the cost of any additional inspection and NZP police officer at overtime rates.

SCHEDULES AND PAYMENTS

59. SCHEDULE OF VALUES

59.1. Submit, to the COTR, a schedule of estimated values of all parts of the work. The breakdown of costs on the Schedule of Values shall follow the divisions used in the project specifications and shall reflect major items and groups of items shown on the Contractor's project schedule. All values shall be in US dollars.

59.2. Wages: Verify wages and comply with regulated wage scales, i.e. Davis-Bacon, Service Contract Act, etc.

60. SCHEDULING & PAYMENTS / BAR CHART [NOT USED]

61. SCHEDULING & PAYMENTS / CRITICAL PATH METHOD

61.1. CPM Scheduling: The work under this project will be scheduled and reported by the Contractor using the Critical Path Method. Submit Project Schedule in both PDF format and original scheduling software format. The approved Project Schedule(s) shall be used by the Contractor for planning, organizing, executing and directing the work; for monitoring and reporting progress; and for requesting payment for work completed. All costs shall be identified in US dollars.

61.1.1. Order and Inter-Dependence of Activities: The Critical Path Method will be followed to show the order and interdependence of activities and the sequence in which the work is to be accomplished. Each activity shall be tied to all activities that must logically precede or follow it and all paths shall be continuous through to completion date(s).

61.1.2. Work Breakdown Parameters for Activities: The activities shown on the network diagram shall include construction activities, submittal processing by the Contractor, submittal processing by the Smithsonian, procurement activities for major equipment, fabrication of special materials and equipment, installation of special materials and equipment, inspections and tests. All field activities that affect progress toward contractually required dates for completion of all or parts of the Work shall be shown. The level of detail shall be such that the duration of any activity will be no longer

than ten (10) working days and no activity will have a dollar value exceeding $15,000, except as allowed by prior and specific approval of the COTR. All aspects of the contract activities are to be identified and priced accordingly in the proposal. This is to include, but shall not be limited to, separate pricing for bonds, insurance, CQC related work, etc. As-built drawings shall also be priced.

61.1.3. Cost-loading of Activities: The Project Schedule shall include a dollar value (cost) for each work activity. The cost shall include labor, materials, equipment, small tools, incidentals and a prorated portion of overhead and profit. The sum of all activity costs shall be equal to the total Contract Price. Each activity cost shall be coded with a cost code corresponding to a line item on the Schedule of Values.

61.1.4. Computer Software: The Contractor shall use a computerized CPM scheduling software designed for use on IBM personal computers. The name of the software proposed for use shall be submitted to the COTR, along with literature about the program's capabilities, functions and operations, demonstrating that the requirements of the entire section entitled "Scheduling of the Work / Critical Path Method" can be met.

61.2. Required Schedules: The Contractor shall prepare and submit a Preliminary Project Schedule, Complete Project Schedule, Condensed Summary Schedule, Progress Schedules and Recovery Schedules as described below.

61.2.1 Complete Project Schedule: Within 30 calendar days after receipt of Notice to Proceed, the Complete Project Schedule shall be submitted to the COTR for review and approval. The Contractor's submission of the Preliminary Project Schedule shall include four (4) copies and one (1) reproducible.

61.2.2. Condensed Summary Schedule: Along with each copy of the Complete Project Schedule, the Contractor shall submit, to the COTR for approval, a condensed summary version consisting of not more than 250 activities summarizing major work elements.

61.2.3. Progress Schedules: Each month, the Contractor shall prepare a Progress Schedule by inputting all information regarding actual start and actual finish dates, projected through the end of the month, into the computerized Project Schedule. Complete discussion of this requirement is contained in the section "Reporting Progress and Applying for Payment."

61.2.4. Recovery Schedule: If the work falls substantially behind the approved Project Schedule the COTR may require the Contractor to submit a Recovery Schedule in accordance with the Construction Contract Clauses paragraphs relating to "Commencement, Prosecution and Completion of Work." Upon request, the Contractor shall submit a Recovery Schedule to the COTR for approval within ten (10) working days. The requirements set forth herein in the sub-paragraph entitled "Complete Project Schedule," shall apply to all activities shown on the Recovery Schedule.

61.3. Changes Related to Requests for Proposals: For all proposals involving requests for time extensions or other significant changes to schedule, the Contractor shall submit a listing of all the

activities affected, added, or deleted (by node numbers). The effect in time and money shall be described for each activity. If, in the opinion of the COTR, the proposed change may impact the completion date(s), the Contractor shall submit a diagram of that portion of the network schedule affected by the changes, along with standard reports for analysis.

61.3.1 Diagrams and reports submitted to illustrate the impact of a proposed change shall show the necessary revisions to activities, along with their costs, durations, and trade responsibilities. Failure to submit such a diagram with a proposal shall constitute a waiver of any claims for time extensions associated with the subject of that proposal.

61.3.2 Modification of activity times shall be agreed to by both the Contractor and the COTR. In the event that agreement on modified activity times cannot be reached, the COTR will direct the specific time adjustments to be entered into the program to determine approved, revised, contract completion dates.

61.4. Response to Application:

60.4.1. Payment shall be made only for progress agreed upon by the COTR, performed on original Contract Work or approved modifications, in accordance with the current, approved Project Schedule. Failure to submit the Application in accordance with the specifications will prevent the processing of payments.

61.4.2. Payments will be mailed to the Contractor's address as identified in the contract documents on record with the Contracting Officer. Any changes of address or requests for wire transfer of progress payments must be made in writing, signed by the Contractor's authorized person and submitted to the Contracting Officer.

62. ASSIGNMENT OF CLAIMS

62.1. Assignment of Claims are subject to the approval of the Contracting Officer. Any Assignment of Claim or subsequent re-assignment shall meet the requirements of the General Conditions contract clause entitled "FAR 52.232-23 Assignment of Claims."

62.2. All documents for assignments shall be written in the English language and shall be original ink signatures of the Contractor and assignee. All monies shall be identified in US dollars.

PROJECT CLOSEOUT REQUIREMENTS

63. PROJECT CLOSEOUT

63.1. Definition: Project closeout is a scheduled process for fulfillment of remaining contract requirements at the end of the project in preparation for final acceptance, final payment, and normal termination of contract, beneficial occupancy and establishment of the warranty period.

64. SUBSTANTIAL COMPLETION

64.1. Definition: The date of Substantial Completion of a project or specified part of a project is the date, as confirmed by inspection by the COTR, when the construction is at least 95% complete and ready for beneficial occupancy, so that the Smithsonian can take possession of that area or part of the work. Portions of the work that are specified to be phased for completion, areas required for Smithsonian's use prior to completion of the total project or items of work identified by the COTR as necessary for partial beneficial occupancy may be inspected for substantial completion separately from the rest of the Work.

64.1.1. The Smithsonian Institution reserves the right to occupy or install equipment in completed areas of the building prior to substantial completion provided that such occupancy does not interfere with the completion of the work. Such partial occupancy shall not constitute acceptance of any part of the work.

64.2. Request for Substantial Completion Inspection: Submit a written request to the COTR for an inspection to establish Substantial Completion status. This request shall specify areas or parts of the work to be considered and shall include a listing of all exceptions to the request, that is, items not considered to be substantially complete.

64.3. Submission of Operation and Maintenance Manuals: Prior to requesting Substantial Completion Inspection, submit, to the COTR, three (3) sets of manuals for all systems and equipment, as specified in the technical sections of this specification. The manuals shall be bound in letter-sized, three-ring, loose-leaf binders with durable plastic covers. They shall be organized into suitable volumes of manageable size using the divisions of the Specifications as a guide. Each manual shall have a table of contents and shall be assembled to conform to the table of contents with tab sheets locating each subject. The instructions shall be legible and easy to read. Where oversize drawings are necessary, they shall be folded to be not greater than letter-size. The words "Operation and Maintenance Manual," the name and location of the project, project number, contract number, date and the name of the general contractor, shall appear on the cover. Data shall be specific to the equipment that is installed and reflect all approved changes and substitutions. Data shall also reflect any required or recommended seasonal adjustments or inspections. Include electronic copy of manual, in PDF format, on CD/DVD. Manuals shall include, as a minimum, the following data:

64.3.1. Detailed description of each system and each of its components, including layout showing piping, valves, controls and other components and including diagrams and illustrations where applicable.

64.3.2. Wiring and control diagrams with data to explain detailed operation and control of each component.

64.3.3. Control sequence describing start-up, operation and shut down.

64.3.4. Procedures for starting, operating and shut down.

64.3.5. Installation instructions.

64.3.6. Maintenance and overhaul instructions.

64.3.7. Lubricating schedule, including type, grade, temperature range and frequency.

64.3.8. Emergency instructions and safety precautions.

64.3.9. On-site acceptance test results for equipment installed under this contract.

64.3.10. Approved product data, shop drawings and system as-builts.

64.3.11. Copies of approved certifications and laboratory test reports (where applicable).

64.3.12. Notarized copies of warranties (originals to be provided as required by "Warranties and Guarantees").

64.3.13. Written instructions for test procedures.

64.3.14. Performance curves and rating data.

64.3.15. Parts list, including source of supply, recommended spare parts and service organization convenient to Smithsonian.

64.3.16. Name, address and telephone number of each subcontractor who installed equipment and systems, local representative for each type of equipment and each system.

64.3.17. Other pertinent data applicable to the operation and maintenance of particular systems or equipment and/or other data as specified Divisions 2 through 16 of the Specifications.

64.4. Other Prerequisites for Substantial Completion Inspection: Complete the following prior to requesting inspection for certification of substantial completion:

64.4.1. Testing and start-up of systems.

64.4.2. Installation of all signage, including accessibility related signs, equipment instructions, identification labels and permanent directional signs.

64.4.3. Submission of spare parts, tools and surplus materials as required in technical specifications. Submit to the COTR an MSDS for each surplus material that contains toxic or hazardous substances. Surplus materials that the SI determines not to retain shall be removed and properly disposed of by the Contractor according to all applicable regulations.

64.4.4. Scheduling of training sessions for Smithsonian personnel.

64.4.5. Removal of all waste, rubbish and temporary facilities and services. Means of access to all areas of the work to be inspected by the COTR shall be maintained.

64.4.6. Disposition of samples and mock-ups not incorporated into the work.

64.4.7. Arrangement for permanent utility connections and billing responsibility transfer to Smithsonian's Office of Facilities Management and Reliability (OFMR).

64.4.8. Arrangement for transfer of security responsibility for the project site and changeover of locks by Smithsonian's Office of Protection Services (OPS).

64.4.9. Hazardous Waste Disposal: Submit copies to the COTR of the following hazardous waste records for hazardous waste generated on SI property and disposed of by contract personnel.

1. Hazardous Waste Manifests
2. Notification and Certification Forms
3. Material Profile Sheet or characterization
4. Container Content Sheets
5. Certificates of Disposal

64.5. Scheduling of the Substantial Completion Inspection: Within seven (7) calendar days after receipt of the Contractor's written request, the COTR will either schedule an inspection or advise the Contractor of work that must be completed or prerequisites that must be met prior to scheduling the Substantial Completion Inspection. In that case, another written request for Substantial Completion Inspection must be submitted when all requirements have been met.

64.6. The Substantial Completion Inspection: The Substantial Completion Inspection will be performed by representatives of the Smithsonian Institution led by the COTR. During the inspection, the COTR will prepare a punch list of deficiencies in the work. If the punch list becomes too extensive the COTR may cancel the inspection and require additional work to be performed for a repeat inspection.

64.6.1. For satisfactory inspection results, the COTR will issue the written punch list to the Contractor as soon as possible after the inspection. Items on the punch list must be completed prior to final acceptance of the total project work.

64.6.2. For unsatisfactory inspection results, the COTR will, within three (3) calendar days, give written notice to the Contractor that the Work or portion of the Work is not substantially complete in accordance with the contract documents and therefore does not meet Substantial Completion status. Requests for re-inspection shall meet all requirements for the original request for Substantial Completion inspection.

64.7. Punch List: Incomplete contract requirements identified during the Substantial Completion Inspection will form an initial basis for a punch list for final acceptance. All punch list items must be completed by the Contractor within the Contract Time. If additional days are needed to complete the punch list items beyond the Contract Time, then the Contractor shall submit, prior to the end of the Contract Time, a written request to the Contracting Officer stating:

64.7.1. Items requiring additional time;

64.7.2. Amount of time needed to complete each item;

64.7.3. Reasons why the items cannot be completed by the contract completion date.

65. FINAL COMPLETION AND ACCEPTANCE

65.1. Definition: The date of final completion of a project is the date, as confirmed by inspection by the COTR, when the Work is satisfactorily completed and accepted in accordance with the contract documents, as amended and/or modified.

65.2. Request for Final Completion Inspection: When all items on the punch list have been corrected to the satisfaction of the COTR and additional requirements as described below have been satisfied, the Contractor shall submit a written request for Final Completion Inspection.

65.3. Prerequisites for Final Completion: Prior to requesting the inspection for certification of Final Completion, the Contractor shall complete the following:

65.3.1. Submission of a copy of a prior punch-list stating that each item has been completed or otherwise resolved for acceptance.

65.3.2. Provision of Instructions to Smithsonian Personnel -where instructions to Smithsonian personnel are specified in other sections, furnish, without additional expense to the Smithsonian, the services of competent instructors, who will give full instruction in the care, adjustment and operation of the systems and equipment to designated Smithsonian employees.

1. Each instructor shall be familiar with all parts of the system on which he or she is to give instruction and shall be knowledgeable about the systems' operation and required maintenance. Factory trained instructors shall be employed wherever practical and available.

2. Unless otherwise required or approved, the instruction shall be given during the regular work week after the equipment has been accepted and turned over to the Smithsonian for regular operation. Where significant changes or modifications in equipment are made under the terms of the contract, additional instruction shall be provided as may be necessary to acquaint the operating personnel of the changes or modifications. Unless otherwise stated, at least half of the time allocated for instruction shall be "hands-on," using the actual system installed.

3. Upon completion obtain written acknowledgment from the COTR that the required instruction was completed.

65.3.3. Posting of operating instructions approved by the COTR for each system and each principal piece of equipment. Include wiring and control diagrams showing the complete layout of the entire system including equipment, piping, valves and control

sequence framed under clear laminated plastic and posted where directed by the COTR. Printed or engraved operating instructions for each principal piece of equipment including start-up, proper adjustment, operating lubrication, shut-down safety precautions, procedure in the event of equipment failure and any other necessary items of instruction as recommended by the manufacturer of the unit shall be attached to or posted adjacent to the piece of equipment. Operating instructions exposed to the weather or wet or humid conditions shall be made of weather-resisting materials or shall be suitably framed and enclosed to be weather protected. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling. The Contractor shall coordinate the location of posted instructions with the COTR.

65.3.4. Provision of equipment demonstrations for each equipment item. Coordinate scheduling of all demonstrations through the COTR.

65.3.5. Submission of original warranties for all products, equipment and systems.

1. Assemble original warranty certificates or notarized copies of warranty certificates executed by the Contractor, Subcontractors, suppliers and manufacturers in a tab-indexed, three-ring loose-leaf binder with a durable plastic cover. Provide electronic copy, in PDF format, on CD. The table of contents shall identify the item covered, the location of the item, the date of Substantial Completion, expiration date of the warranty and the supplier, vendor and installing contractor. Duplicate notarized copies of warranties shall be provided as required by "Manuals for Operation, Maintenance and As-Built Product Data."

2. Each warranty certificate or bond shall identify the date(s) for:

(1) Substantial Completion status in accordance with project closeout requirements.

(2) Beginning and ending of the warranty period.

(3) Provide any coincidental product warranty, which is available on a product incorporated in the Work, but for which the warranty is not specifically required by the contract documents.

3. Warranty of Construction: Warrant that the work performed under this Contract conforms to the Contract requirements and is free of any defect in equipment, materials, design furnished or workmanship performed by the Contractor or any subcontractor or supplier at any tier. Unless otherwise stated in the technical sections of the Specifications, the warranty of the Work shall continue for a period of one (1) year from the date of Final Completion status. If the Smithsonian takes partial occupancy before Final Completion, then the warranty for that portion shall be in effect for a period of one (1) year beginning on the date of Substantial Completion for that portion of the Work.

4. Response Time for Warrantee Items – For all items under the warrantee period that are deemed by the COTR as essential to the 24/7 operations of the facility, the Contractor will provide (at no additional cost to SI) emergency response and corrective actions as required (in less than 4 hours). Provide 24/7 contact personal.

65.3.6. [NOT UED]

65.3.7. Arrangement for change-over locks through the COTR and Smithsonian Office of Protection Services as required for security for Smithsonian occupancy.

65.3.8. Submission of evidence of payment and transfer date of utility company accounts for those utilities previously billed to the Contractor during construction, as necessary.

65.3.9. Submission of evidence that all regulatory agency permit and code requirements have been completed and recorded, as necessary.

65.3.10. Submission of a signed, written statement that no damage has occurred to the site as documented by the pre-condition survey report.

65.3.11. Final clean up, including:

1. Sweep and dust all surfaces and wash all finished surfaces to appear new and free of all stains, soil marks, dirt and other forms of defacement.

2. Remove labels that are not required as permanent labels.

3. Clean transparent materials, including mirrors and window/door glass, to a polished condition, removing substances that are noticeable as vision-obscuring materials. Replace broken glass and damaged transparent materials.

4. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of dust stains, films and similar noticeable substances. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces. Restore reflective surfaces to original reflective condition.

5. Wipe surfaces of equipment clean. Remove excess lubrication and other substances.

6. Remove debris and surface dust from limited-access spaces including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics and similar spaces.

7. Wet-mop concrete and clean other hard-surface floors according to manufacturers' recommendations.

8. Vacuum clean carpeted surfaces and similar soft surfaces.

9. Clean plumbing fixtures to a sanitary condition, free of stains including those resulting from water exposure.

10. Clean project site (yard and grounds) of litter and foreign substances. Sweep exterior paved areas to a broom-clean condition; remove stains, petro-chemical spills and other foreign deposits. Rake grounds, which are neither planted nor paved, to a smooth, even textured surface.

65.4. Inspection of the Work for Final Completion: Upon receipt of the Contractor's written notice that the work has been completed, the COTR will inspect the work to confirm Final Completion status and acceptance of the work. As soon as possible after inspection, the COTR will either provide written acknowledgment of final acceptance or advise the Contractor of work not completed or obligations not fulfilled as required for final completion and acceptance.

65.5. Application for Final Payment:

64.5.1. Application for Final Payment shall be submitted only after Final Acceptance has been certified in writing to the Contractor by the COTR. Application shall include final labor data and progress schedule update.

64.5.2. Final Payment will be approved when Final Acceptance has been certified and the following conditions have been met:

1. Certification signed and submitted by the Contractor that all contract requirements, including contract modifications, have been met.

2. Final Release of Claims submitted.

3. Release of assignment of claims or consent of surety submitted, as necessary.

4. All security ID badges and parking permits returned to Smithsonian.

5. As-Built Record Drawings Submitted: During the progress of the work maintain a complete and up-to-date set of record prints, open to inspection by the COTR at any time. These prints shall provide a complete and accurate as-built record of all changes to the Contract Drawings, including rerouting of runs, relocation of items or control points and all other modifications. The exact location of pipes, conduit or other features concealed underground, under concrete, in chases or above ceilings shall be shown by perpendicular dimensions from at least two available landmarks. As-built drawings shall be neatly marked with colored pencils or ink, marked "As-Built" and signed and dated by the Contractor. Upon completion of the Work and before final payment, the Contractor shall submit the following to the COTR: photographically produced as-built record drawings on 4-mil, double matte, Mylar sheets, sized the same as the contract drawings; electronic copies of as-built record drawings in PDF and DWG formats.

6. As-Built Record Survey of Underground Utilities Submitted: If outside or underground utilities are part of the work, furnish, to the COTR for approval, an acceptable and accurately dimensioned (GIS) survey showing location and elevation of underground storage tanks, all utility lines for water, gas, electrical, sewer, steam, etc., including valves, connections and changes in direction, as installed under the Contract, within the property lines and outside the building walls. Points where utility lines emerge from the building shall be located from lot monuments. The survey shall be made to scale and must be marked "As-Built" and signed and dated by the Contractor. The Contractor shall furnish an electronic copy of as-built record drawings in PDF and DWG formats to the COTR on the same size as the contract drawings

7. As-Built Record Specifications Submitted: submit one (1) hard copy and a digital (scanned) set of project specifications with annotations to identify any changes made during construction, referencing modification numbers, dates and originators of authorizing letters or memos and other sources of changes. The cover shall be marked "As-Built" and signed and dated by the COTR.

Construction and Demolition Waste Tracking Sheet:
To be submitted with each application for payment for the payment period, and at project completion with total waste data and total percentage of waste diverted from landfill for entire project period.

Project Name: _____
Start Date: _____
End Date: _____

Material Description	**Disposal date**	**Diverted from Landfill or incinerator? (Y/N)**	**Diversion method (Recycled, Salvaged, etc.)**	**Hauler or Destination (submit receipts)**	**Volume (in cubic feet)**	**Weight (in tons)**
Land Clearing Debris						
Gypsum Wallboard Scrap						
Cardboard						
Paper goods						
Beverage containers						
Assorted Plastic						
Wood Pallets						
Asphaltic Concrete Paving						
Concrete						
Brick						
CMU						
Lumber						
Plywood and OSB						
Wood Paneling						
Wood Trim						
Miscellaneous Metals						
Structural Steel						
Rough Hardware						
Insulation						
Roofing						
Doors and Frames						
Door Hardware						
Windows						
Non-Window Glass						
Glazing						
Acoustical Tile						

Material Description	**Disposal date**	**Diverted from Landfill or incinerator? (Y/N)**	**Diversion method (Recycled, Salvaged, etc.)**	**Hauler or Destination (submit receipts)**	**Volume (in cubic feet)**	**Weight (in tons)**
Carpet						
Carpet Pad						
Demountable Partitions						
Equipment						
Cabinets						
Plumbing Fixtures						
Piping						
Piping Supports and Hangers						
Valves						
Sprinklers						
Mechanical Equipment						
Electrical Conduit						
Copper Wiring						
Light Fixtures						
Lamps						
Lighting Ballasts						
Electrical Devices						
Switchgear and Panel boards						
Transformers						
Other:						
Other:						
Other:						
				Total Diverted		
				Total Not Diverted		
				Total All Waste = Total Diverted + Total Not Diverted		
				% Diversion Rate* = Total Diverted/Total All Waste		

**Percentage Diversion Rate to be compiled after project completion. Minimum Diversion rate is 50%. Goal Diversion rate is 75%*

END OF SUPPLEMENTARY CONDITIONS FOR CONSTRUCTION

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

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 general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

1.3 DEFINITIONS

A. Caliper: Diameter of a trunk measured by the average of the smallest and largest diameters] at 6 inches above the ground for trees up to, and including, 4-inch size; and 12 inches above the ground for trees larger than 4-inch size.

B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

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

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of the following:

1. Organic Mulch: 1-quart volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.

C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified arborist and tree service firm.

B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

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

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.6 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA.

B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:

a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
b. Enforcing requirements for protection zones.
c. Arborist's responsibilities.

d. Field quality control.

1.7 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:

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

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

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

1. Type: Shredded hardwood
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

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

1. Chain-Link Fencing: Install four foot high chain-link fencing to comply with ASTM F 567 and with manufacturer's written instructions.
2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to COTR-Smithsonian Institute.
3. Access Gates: Install as needed to access the work site. Adjust to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

4. Retain one or more of first four subparagraphs below for protection-zone fencing. Fence materials are listed in order of strongest to weakest. Retain stronger fencing where damage potential to an individual tree, group of trees, or plantings is higher. Revise post and rail diameters to suit fence height and strength required. The more expensive polymer coating may have better appearance but may be less visible to workers.

5. Gates: swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Tie a 1-inch blue-vinyl tape around each tree trunk at 54 inches above the ground.

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

C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.

1. Apply 4-inch average thickness of organic mulch. Do not place mulch within 6 inches of tree trunks.

3.3 TREE- AND PLANT-PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at

vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

B. Maintain protection zones free of weeds and trash.

C. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by COTR-Smithsonian Institute.

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

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "Earth Moving."

B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

A. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Cut Ends: Do not paint cut root ends.
3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
4. Cover exposed roots with burlap and water regularly.
5. Backfill as soon as possible according to requirements in Section 312000 "Earth Moving."

B. Root Pruning at Edge of Protection Zone: Prune roots 12 inches outside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation 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.

3.6 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches **as follows:**

1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:

    a. Type of Pruning: Cleaning, Thinning and Reduction.

3. Cut branches with sharp pruning instruments; do not break or chop.
4. Do not apply pruning paint to wounds.

B. Chip removed branches and dispose of off-site unless otherwise directed by COTR for use in other locations within the Zoo.

3.7 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.8 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

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

1. Submit details of proposed root cutting and tree and shrub repairs.
2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
4. Perform repairs within 24 hours.
5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by COTR-Smithsonian Institute.

B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that COTR-Smithsonian Institute determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size and species as those being replaced for each tree that measures 4 inches or smaller in caliper size.
2. Provide two new tree of 4- caliper size for each tree being replaced that measures more than 6 inches in caliper size.

    a. Species: Species selected by COTR-Smithsonian Institute.

3. Plant and maintain new trees as specified in Section 329300 "Plants."

C. Soil Aeration: Where directed by COTR-Smithsonian Institute, aerate surface soil compacted during construction. Aerate 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Smithsonian Institute property.

END OF SECTION 015639

SECTION 01 5713 – TEMPORARY EROSION AND SEDIMENT CONTROL

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 requirements for temporary erosion and siltation control measures.

1.3 APPLICABLE SPECIFICATIONS

A. DOEE Construction Standards and Specifications.

B. DOEE Erosion and Sediment Control Manual

C. DOEE Erosion and Sediment Control Details

1.4 INFORMATIONAL SUBMITTALS

A. Erosion and Sedimentation Control Plan: Prior to the start of the work the Contractor shall prepare and submit a plan for applying temporary and permanent erosion and siltation control measures. The plan shall include, but is not limited to, the operations of clearing and grubbing, stripping of topsoil, grading, stabilizing cleared areas, dewatering, and the construction of structures at watercourses. Construction work shall not commence until the schedule of work and the methods of operations have been reviewed and approved by the Engineer.

B. Temporary measures shall be coordinated with the construction of permanent drainage facilities and other contract work to the extent practicable to assure economical, effective, and continuous erosion and sediment control, and to prevent any damage, clogging, or other negative impacts upon the Work or other property.

1.5 PROJECT CONDITIONS

A. Retain this article to impose responsibility for maintenance and protection of permanent services and facilities used to provide temporary service and facility. Unless otherwise specified, the Contractor is responsible for obtaining and complying with any and all applicable State, Federal, and Local permits which are required for construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials shall be at the Contractor's option with the approval of the Engineer in accordance with DOEE.

PART 3 - EXECUTION

3.1 INSTALLATION AND MAINTENANCE OF EROSION AND SEDIMENT CONTROL

A. No grading operations will be allowed until temporary sediment and erosion control measures have been installed in accordance with the approved plan.

B. Control measures shall be periodically cleaned of silt and maintained. Immediately after every rainstorm, all control measures shall be inspected and any deficiencies corrected by the Contractor.

C. DOEE reserves the right to order the performance of other temporary measures not specifically described herein to correct an erosion or siltation condition.

D. Temporary control measures may be removed when the area has been stabilized.

3.2 EXTENT OF GRADING OPERATIONS

A. The Contractor shall limit the surface area of earth material exposed by grubbing, stripping of topsoil and excavation to that which is necessary to perform the next operation within a given area.

B. Unless specifically authorized by the Engineer, the grubbing of root mat and stumps shall be confined to the area over which excavation is to be actively prosecuted within 30 days following the grubbing operations.

C. The stripping of topsoil shall be confined to the area over which excavation is to be actively prosecuted within 7 days following the stripping operations; and excavation and embankment construction shall be confined to the minimum area necessary to accommodate the Contractor's equipment and work force engaged in the earth moving work.

D. No disturbed area, is to remain denuded longer than 7 days without temporary seeding or otherwise stabilizing the area.

3.3 DEWATERING AND DISCHARGES

A. All dewatering operations shall be conducted in a manner that prevents or minimizes the amount of sediment or other pollutants which discharge to the storm sewer system, which includes curb and gutter, or any open watercourse. Any discharge from dewatering operations shall be properly filtered prior to being discharged. Dewatering activities shall not create any erosion nor flooding. A dewatering plan must be included as part of the Erosion and Sediment Control plan with sufficient detail to ensure that the proposed dewatering will meet all applicable requirements.

B. All non-stormwater discharges to the DC Water's storm sewer system, which includes curb and gutter, or any open watercourse must comply regulations. Contaminants, including but not limited to, volatile organic compounds, petroleum products, metals, PCBs/Pesticides, shall not be discharged to the DC Waters storm sewer system without approval from DC Water.

C. Contractors shall not dump or dispose of anything in a storm drain, street, stream, or riparian area that could cause adverse conditions. Contractors shall employ good housekeeping and pollution prevention measures at work sites at all times. Work areas, including staging or stockpile areas, shall be kept clean and free of trash and debris to the maximum extent possible. Construction materials shall be properly stored and secured. Stockpiled materials shall be kept covered and perimeter controls shall be employed to minimize exposure to wind, precipitation, and runoff. Equipment and vehicle washing shall not be permitted onsite without proper controls and facilities to collect all sediment and/or pollutants. Spill kits and appropriate tools for cleanup shall be kept on-site at all times. Spills shall be cleaned immediately using absorbent materials or other appropriate measures which will prevent any pollutants from entering a storm drain or open watercourse.

END OF SECTION

SECTION 02 4119 – SELECTIVE DEMOLITION

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. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. 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.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of

interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Pre-Demolition Conference: Conduct conference at the Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Site Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

E. Pre-Demolition Photographs or Video: Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

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

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively 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. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

F. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

G. Storage or sale of removed items or materials on-site is not permitted.

H. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

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

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect and Owner.

E. 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 selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
2. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Erosion and Sediment Control."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.

3.4 SELECTIVE SITE 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. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.

C. Removed and Salvaged Items:

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 Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE SITE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Cut concrete full depth at junctures with construction to remain and at regular interals using power-driven saw, and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

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. Burning: Do not burn demolished materials.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 033000 - CAST IN PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.

B. Concrete foundations.

C. Concrete reinforcement.

D. Miscellaneous concrete elements, including equipment pads.

E. Concrete curing.

1.02 REFERENCE STANDARDS

A. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials 2010 (Reapproved 2015).

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete 1991 (Reapproved 2009).

C. ACI 301 - Specifications for Structural Concrete 2016.

D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete 2000 (Reapproved 2009).

E. ACI 305R - Guide to Hot Weather Concreting 2010.

F. ACI 306R - Guide to Cold Weather Concreting 2016.

G. ACI 308R - Guide to External Curing of Concrete 2016.

H. ACI 318 - Building Code Requirements for Structural Concrete and Commentary 2014 (Errata 2018).

I. ACI 347R - Guide to Formwork for Concrete 2014, with Errata (2017).

J. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2020.

K. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2018a.

L. ASTM C33/C33M - Standard Specification for Concrete Aggregates 2018.

M. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens 2020.

N. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete 2020.

O. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens) 2020b.

P. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete 2010a (Reapproved 2016).

Q. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete 2019.

R. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete 2019.

S. ASTM C845/C845M - Standard Specification for Expansive Hydraulic Cement 2018.

T. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2017.

U. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete 2012.

1.03 SUBMITTALS

A. See Section 010000 for submittal procedures.

B. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
   2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.

C. Test Reports: Submit report for each test or series of tests specified.

D. Sustainable Design Submittal: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.

1.04 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

B. Follow recommendations of ACI 305R when concreting during hot weather.

C. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.

B. Form Materials: COTR's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
   2. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches (38 mm) of concrete surface.

2.02 REINFORCEMENT MATERIALS

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa).
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished, unless otherwise indicated.

B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.
   1. Form: Coiled Rolls.
   2. WWR Style: As indicated on drawings.

C. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch (1.29 mm).
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches (38 mm) of weathering surfaces.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
   1. Acquire cement for entire project from same source.

B. Blended, Expansive Hydraulic Cement: ASTM C845/C845M, Type K.

C. Fine and Coarse Aggregates: ASTM C33/C33M.

D. Fly Ash: ASTM C618, Class C or F.

E. Calcined Pozzolan: ASTM C618, Class N.

F. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Air Entrainment Admixture: ASTM C260/C260M.

C. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.

D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

E. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.

F. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

G. Water Reducing Admixture: ASTM C494/C494M Type A.

H. Shrinkage Reducing Admixture:
   1. ASTM C494/C494M, Type S.

2.05 ACCESSORY MATERIALS

A. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Grout: Comply with ASTM C1107/C1107M.
   2. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: 7,000 pounds per square inch (48 MPa).
   3. Low-Slump, Dry Pack Products:
      a. Euclid Chemical Company; DRY PACK GROUT: www.euclidchemical.com/#sle.
      b. Five Star Products, Inc; Five Star Grout: www.fivestarproducts.com/#sle.
      c. SpecChem, LLC; SC Multipurpose Grout: www.specchemllc.com/#sle.

2.06 CURING MATERIALS

A. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
   1. Product dissipates within 4 to 6 weeks.

B. Water: Potable, not detrimental to concrete.

2.07 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
   1. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
   1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

D. Normal Weight Concrete:
   1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on the drawings.
   2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
   3. Calcined Pozzolan Content: Maximum 10 percent of cementitious materials by weight.
   4. Water-Cement Ratio: Maximum as indicated on the drawings.
   5. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M.
   6. Maximum Aggregate Size: 3/4 inch (19 mm).

2.08 MIXING

A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.

B. Transit Mixers: Comply with ASTM C94/C94M.

C. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
   1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Notify COTR not less than 24 hours prior to commencement of placement operations.

C. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

D. Ensure reinforcement, inserts, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

E. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

3.05 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch (6 mm) or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch (6 mm) or more in height. Provide finish as follows:
   1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.

3.06 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven days.

C. Surfaces Not in Contact with Forms:
   1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
   2. Final Curing: Begin after initial curing but before surface is dry.
      a. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.07 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards (76 cu m) or less of each class of concrete placed.

F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.08 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to COTR within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the COTR. The cost of additional testing shall be borne by COTR when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of COTR for each individual area.

3.09 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

SECTION 055000 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Steel vertical posts and rails.
2. Miscellaneous steel weld plates.
3. Steel base plates.
4. Double-sided gate latches.

B. Products furnished, but not installed, under this Section include the following:
1. Anchor bolts, or other inserts indicated to be cast into concrete.
2. Steel weld plates and angles for anchoring into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, wedge-type inserts, and other items cast into concrete.
2. Section 055964 “Metal Welded Mesh Enclosures” for welded wire mesh fabric at vertical walls of Animal Containment systems, mesh infill panels and fittings.
3. Section 09960 "High Performance Coating”

1.3 PERFORMANCE REQUIREMENTS

A. The design intent is to provide a System of drilled pier foundations, steel framing, and steel cables to support the mesh enclosure.

B. The Contractor’s Professional Engineer (the Designer) shall design the steel framing to resist the loads indicated on the drawings. Alternate framing to that shown on the drawing is acceptable provided it meets the performance requirements and the contract documents.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type product.

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 vertical posts.
2. Steel framing and supports.
3. Steel cable and mesh infill panels and fittings.

C. Shop Drawings detailing fabrication of structural steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.
4. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other sections.
5. Erection details indicating field welding and slip critical and fully tensioned bolted connections.
6. Delegated-Design Submittal: Drawings and calculations for all steel posts, foundations, cables, cables erection lengths, mesh infill and fittings related to the tensioned cable structure. Delegated Design submittal shall be signed and sealed by a Registered Professional Engineer currently licensed in the District of Columbia.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Mill test reports for structural steel, including chemical and physical properties.

C. Welding certificates.

D. Product Test Reports: For the following:
1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Tension-controlled, high-strength, bolt-nut-washer assemblies.
3. Nonshrink grout

E. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

F. Survey of existing conditions.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 “Quality Requirements,” to design steel posts, foundations, cables, cables erection lengths, mesh infill and fittings.

B. Structural Performance of mesh enclosure including cable erection lengths, mesh infill and fittings: shall withstand the effects of loads and stresses within limits and under conditions specified for the following. See Design Loads in the Design Notes section of the structural drawings for further details on load criteria.
1. Wind loads per ASCE 7
2. Ice loads per ASCE 7.
3. Snow loads per ASCE 7.

C. Foundations per specification section 316329, “Drilled Concrete Piers and Shafts.”

D. Mock-up of double-sided gate latch. Provide a fabricated mock-up for the double-sided gate latch, with sections of the gate frame and gate post to show spatial relationships, for demonstration/operation of the latch for approval prior to further fabrication.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M, unless otherwise indicated.

D. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

E. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

F. Galvanized Steel Bridge Strand: ASTM A 603

G. Steel Mesh
1. See section 055964 “Metal Welded Mesh Enclosures”.

H. Clevises and Turnbuckles: Galvanized high strength steel. Selected for required strength.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide hot dipped galvanized fasteners for exterior use. Select fasteners for type, grade, and class required

B. Headed Anchor Rods: ASTM F 1554, Grade 55, weldable, straight.

1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
4. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

E. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 09960 "High Performance Coatings".

B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. Concrete: Comply with requirements in Section 03 3000 "Cast-in-Place Concrete".

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 (1 mm) 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.

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. Furnish inserts for units installed after concrete is placed.

C. Galvanize and paint miscellaneous framing and supports where indicated.

2.7 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.8 STEEL FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel hardware and with ASTM A 123/A 123M for other steel products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

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.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect bolted connections.
4. Verify cable connections and fittings.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.

c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

SECTION 055964 – METAL WELDED MESH ENCLOSURES

PART 1 GENERAL

1.1 GENERAL

Work Included

A. Welded or Crimped Wire Mesh Panels, and Doors.

B. Shop Fabricated Galvanized and Welded Ferrous Metal Framing for Animal Enclosures.

C. Cover panels and plates.

D. Miscellaneous Shop Fabricated Galvanized Ferrous Metal Items Required for a Complete and Proper Installation.

1.2 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   1. Specification section 033000, “Cast-In-Place Concrete.”
   2. Specification section 055000, “Metal Fabrications.”
   3. Specification section 099600, “High Performance Coatings.”

1.3 PRE-QUALIFIED MANUFACTURER’S AND INSTALLERS

B. Only Subcontractors whose experience and workmanship that have been previously reviewed and pre-qualified by the Architect for the Work of this Section. Qualifications for companies not listed herein include a minimum of ten (10) years experience in metal work of this type, plus a minimum of three (3) similar projects involving containment of animals. Companies requesting consideration shall submit written and photographic proof of previously performed projects.

C. Subject to the compliance with the requirements of these Specifications, pre-qualified fabricators and installers for all caging include, but are not limited to, the following:

   1. Thermeq: 1070 Disher Dr., Waterville, OH 43566, (419) 878.4400.

   2. LGL Animal Care Products, Inc.: 1520 Cavitt Street, Bryan, TX 77801, (409) 775.1776.

3. A thru Z Consulting and Distributing: 8620 E. Old Vail Rd., Tucson, AZ 85747, (520) 434-8281.

1.4 REFERENCES

A. AM A36–Structural Steel.

B. ASTM A53–Hot-Dipped Zinc-coated Welded and Seamless Steel Pipe.

C. ASTM A325–High Strength Bolts for Structural Steel Joints.

D. ASTM A386–Zinc-Coating (Hot-Dip) on Assembled Steel Products.

E. ASTM A500–Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

F. ASTM A501–Hot-formed Welded and Seamless Carbon Steel Structural Tubing.

G. ASTM ASO I–Hot-formed Welded and Seamless Carbon Steel Structural Tubing.

H. ASTM A780–Repair of Damaged Hot-dip Galvanized Coatings.

I. AWS D1.1–Structural Welding Code.

J. FS TT-P-641–Primer Coating, Zinc Dust-Zinc Oxide (for Galvanized Surfaces).

K. FS TT-P-645–Primer, Paint, Zinc Chromate, Alkyd Type.

L. NAAM Standard HMMA 863–Guide Specifications for Detention/Security Hollow Metal Doors and Frames.

1.5 FIELD MEASUREMENTS

A. Prior to submission of shop drawings, the Caging Contractor shall verify that all field measurements are as indicated on Drawings and notify the Architect in writing of any major discrepancies. No fabrication shall proceed until all inconsistencies are corrected.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions. Caging not fitting the conditions as detailed and specified shall be rejected and replaced at no cost to the Smithsonian Institute.

1.6 COORDINATION

A. Contractor shall coordinate with the finish hardware requirements to provide for

smooth operation with minimal efforts as approved by the Owner and Architect.

B. Coordinate with concrete and masonry trades for installation details required.

C. Secondary Containment Areas: Contractor shall be responsible to maintain the joints, attachments, and clearances to equal the detailed dimensions and connections required for the primary enclosure unless otherwise noted.

1.7 SUBMITTALS

A. Submit Shop Drawings, Field Mock-up, and Samples to the requirements in Division 1 of specifications.

B. Shop Drawings:

.1 Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, door hardware, and accessories.

.2 Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS welding Symbols. Indicate net weld lengths.

.3 Detailed drawings for steel mesh panels and frames, hardware and operators.

C. Samples:

.1 Submit one 24” x 24” sample of each wire mesh type specified, showing typical termination conditions, typical welded connections, and other pertinent construction components. Approved sample will be retained by the Architect. Submit additional samples as may be required returned to the contractor.

D. Production runs of all components shall be contingent on the results of the review process and acceptance of the working mock-up.

E. Engineers Calculations: Provide engineering services as required.

1.8 INFORMATIONAL SUBMITTALS

D. Qualification Data: For professional engineer.

E. Welding certificates.

F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

G. Survey of existing conditions.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 MESH PANEL ASSEMBLIES

A. Wire Mesh Panel Assemblies: Refer to drawings for panel assembly components fabricated as follows:

.1 Mesh Panels: Match existing mesh and gage of existing panels assemblies, woven wire crimped mesh and woven wire welded mesh w/ galvanized after weld finish. Frame walls are composed of HSS as indicated on the drawings, with joints welded continuously on animal side and ground smooth, and with no open ends typical. Anchor HSS frame to slab with shim space and with minimum of two (2) anchor bolts adjacent to each HSS post connected to slab through the frame base angle detailed. At angle frames, connect the sill member to slab with shim space and anchor bolts spaced at 2 feet on center minimum. Provide continuous mesh with joints only if unavoidable and if supported continuously by metal frame members. Provide 3/8-inch weeps in lower horizontal member HSS at 24 inches on center in the bottom of enclosed HSS sections.

1. Kudu Interior sliding door mesh: 2”x2”, 6 gauge woven wire hot-dipped galvanized mesh secured to gates and adjacent panels next at locking/latching mechanisms. Mesh to be welded to frame of tube steel 2” x 2” x 3/16”. Each strand of the mesh shall be welded to the frame with ¾” long “J” weld.

2. Hornbill Yard enclosure wall panel mesh, ceiling and doors: 2”x2”, 6 gauge woven wire hot-dipped galvanized mesh secured to gates and adjacent panels next to locking/latching mechanisms. Secured by continuous galvanized steel angle, per details.

B. Steel Sections: ASTM A236, galvanized after welding typical.

C. Cords and Wires: Galvanized Steel.

D. Exposed Mechanical Fastenings: Flush countersunk torx or hex socket machine screws and bolts; stainless steel finish; unobtrusively located; consistent with design of component, except where specifically noted otherwise. Fasteners, Bolts, Nuts, and Washers: ASTM A325; all bolts, machine screws and fasteners shall be A316 stainless steel.

E. Welding Materials: AWS D1.1; type required for materials being welded.

F. Touch-up Primer for Galvanized Surfaces: ZRC or approved equal to match color of galvanized panels for all field welded surfaces. Cold galvanizing is intended for limited touch-up only and will be acceptable only for those areas necessary for field welds.

G. Mesh finishes:

.1 Galvanized mesh typical unless otherwise scheduled:

.1 Woven Welded Wire Mesh: Weight of Metallic (Zinc) Coating: ASTM A 392, Type II, Class 2, 2.0 oz./sq. ft. (610 g/sq. m) with zinc coating applied after welding.

.2 Woven Wire Mesh: Weight of Metallic (Zinc) Coating: ASTM A 392, Type II, Class 2, 2.0 oz./sq. ft. (610 g/sq. m) with zinc coating applied before weaving.

.3 09 9600. High Performance Coatings

H. Anchor Bolts: Hilti countersunk flathead hex socket "Kwik-Bolts," or approved equal, stainless steel finish, for installation in monolithic concrete in sizes indicated on the Drawings, unless specifically noted otherwise.

PART 3 - EXECUTION

3.1 PREPARATION OF STEEL ASSEMBLIES

.1 Verify dimensions onsite prior to shop fabrication.

.2 Clean surfaces of rust, scale, grease, and foreign matter prior to priming.

.3 Fabricate items with joints tightly fitted and secured. Make exposed joints butt tight, flush, and hairline. All oversized holes required for fabrication shall be welded and plugged. No holes, cavities, or other voids will be acceptable, unless specifically designed into the caging system.

.4 Continuously seal joined members by continuous welds.

.5 Fit and shop assemble in largest practical sections, for delivery to site.

.6 Grind exposed welds flush and smooth with adjacent finished surface. Ease exposed edges to small uniform radius of 1/8". Radius all comers to 1/4".

.7 Provide weep holes in closed HSS sections, 3/8 inch diameter.

3.2 COORDINATION

Coordinate all material requirements with other pertinent specification Sections relevant to the Work of this Section.

3.3 FINISHES

Cold galvanized coating at all field welds.

3.4 INSTALLATION

Install items plumb and level, accurately fitted, free from distortion or defects.

Perform field welding in accordance with ASW D1.1.

Remove all sharp edges, burrs, corners and slivers which, in the opinion of the COTR could injure animals or care givers.

3.5 WELDING REQUIREMENTS

All exposed welds shall be ground smooth and galvanized.

Remove all sharp edges, burrs, corners and slivers, which in the opinion of the COTR, could injure animals or keepers.

3.6 APPROVALS

Obtain written approval of the finish coating manufacturer for the shop primed surfaces.

END OF SECTION 055964

SECTION 055965 – VERTICAL AND HORIZONTAL SLIDING DOORS

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. Animal Transfer door assemblies:
      a. Vertical sliding doors and panels. (Guillotines)
      b. Sliding doors and panels
      c. Cover panels and plates.
      d. Locking/latching mechanisms.
      e. Miscellaneous shop fabricated operating hardware and steel shapes.
   2. Cast-in-place anchors required for installation.

   Related Sections:

   3. Division 01 for general requirements for caging work, including responsibilities of a single-source caging specialist; and coordination requirements with the Animal Management personnel.
   4. Division 03 Section "Cast-in-Place Concrete" for building anchors into concrete construction.
   5. Section 323113 - “Fences and Gates.”
   6. Section 055000 - Metal Fabrications
   7. Section 055964 - Metal Welded Mesh Enclosure
   8. Section 066000 - Plastic Lumber

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for detention enclosures.

B. Shop Drawings: For vertical sliding door panels and frames, sliding door panels and frames, operating and hardware. Include plans, elevations, sections, details, and attachments to other work.

   1. Indicate location, plan, dimension and detail drawings of each door.

2. Indicate type of steel and mesh for each component.
3. Indicate preparation required for Finish Hardware and control system hardware, size, and type of fasteners and accessories.
4. Show elevations of each door and indicate location, dimensions, door slide direction, details of door hardware and accessories, and preparations for control systems. If any, indicate welded connections using standard AWS welding Symbols. Indicate net weld lengths.Delete "Samples for Initial Selection" Paragraph above if colors and other characteristics are preselected and specified or scheduled. Retain first paragraph below with or without above.Samples for Verification: For each type of caging enclosure indicated Samples for Verification: For each type of caging enclosure indicated

C. Samples for Verification: For each type of door indicated.

1. Prototype: Submit one working vertical sliding door, and one working sliding door, with frame for each type. Components with locking mechanisms shall be installed at a location selected by the COTR-Smithsonian Institute. Prototypes may be installed as part of the Work if all safety and design standards have been met as determined by the COTR-Smithsonian Institute.

D. Qualification Data: For qualified Fabricator and Installer.

E. Engineer's Calculations:

1. Provide structural analysis to comply with the design loads of 'Exposure Category C' as indicated by DC Building Code, Chapter 16 Structural Design. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation to satisfy code requirements.

1.4 QUALITY ASSURANCE

A. Fabricator and Installer Qualifications:

1. Only Subcontractors whose experience and workmanship have been previously reviewed and pre-qualified by the COTR/Exhibit Designer for the Work of this Section. Qualifications for companies not listed herein shall include a minimum of ten (10) years experience in metal work of this type, plus a minimum of three (3) similar projects involving containment of animals. Companies requesting consideration shall submit written and photographic proof of previously performed projects together with the contact name and phone number of the project COTR lead maintenance and operations person.

B. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with fencing enclosures by field measurements before fabrication.
   1. Prior to submission of shop drawings, the door manufacturer shall verify that all field measurements are as indicated on Drawings and Schedules, and notify the COTR- Smithsonian Institute in writing of any major discrepancies. No fabrication shall proceed until all inconsistencies are corrected.
   2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

1.6 COORDINATION

A. Coordinate installation of anchorages for caging enclosures. 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 adjacent construction. Deliver such items to Project site in time for installation. Contractor shall coordinate to provide for smooth operation with minimal efforts as approved by the COTR- Smithsonian Institute. Any conditions detrimental to door operation as specified shall be brought to the attention of the Architect prior to fabrication.

   1. Coordinate with concrete, shotcrete, and masonry trades for installation details required.

1.7 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. Security Fasteners: Furnish not less than one box for every 50 boxes or fraction thereof, of each type and size of fastener installed.
   2. Tools: Provide two sets of tools for installing and removing security fasteners.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, registered in the District of Columbia, to design welded-wire fences and gate frameworks and supports.

B. Assembly materials shall meet the performance requirements specified.

C. Design Requirements:

1. Provide complete design, calculations, and drawings, prepared, and signed in accordance with pertinent provisions of these Specifications.
2. Maintain the general design concept shown, without decreasing or increasing sizes of members and without altering profiles and alignment, except as otherwise approved by the COTR.
3. Make necessary provisions in the design to accommodate stresses to be encountered.
4. Provide secure edge connections along panel perimeters as shown on the drawings to curb, wall, or metal mesh of dig barrier and existing animal holding areas.
5. Detail connections that maintain a maximum gap of 2 inch between the enclosure and any adjacent structures.

2.2 PRE-QUALIFIED MANUFACTURER'S AND INSTALLERS

A. Only Subcontractors whose experience and workmanship that have been previously reviewed and pre-qualified by the Architect for the Work of this Section. Qualifications for companies not listed herein include a minimum of ten (10) years' experience in metal work of this type, plus a minimum of three (3) similar projects involving containment of animals. Companies requesting consideration shall submit written and photographic proof of previously performed projects.

B. Subject to the compliance with the requirements of these Specifications, pre-qualified fabricators and installers for all caging include, but are not limited to, the following:

1. Thermeq Co.: 1070 Disher Drive, Waterville, OH 43566, (419) 878-4400.
2. A thru Z Consulting and Distributing: 8620 E. Old Vail Rd., Tucson, AZ 85747, telephone: (520) 434-8281
3. LGL Animal Care Products, Inc., 721 Peach Creek Cut-Off Road College Station, TX 77845, telephone:(979) 690-3434

2.3 MATERIALS

A. Mild Steel Plates, Shapes, and Bars: ASTM A 36.

B. Cold-Rolled Steel Sheet: ASTM A 1008, CS (Commercial Steel), Type B, suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A 1011, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A 653, CS (Commercial Steel), Type B; with G90 zinc (hot-dip galvanized).
   1. Steel Cover Plate: 10-gauge steel sheet, pre-drilled for fasteners prior to galvanizing.

E. Steel Tubing: ASTM A 501 or ASTM A 513, Type B unless otherwise indicated. Galvanized after welding typical.

F. Round Rods: Fabricated from material with same chemical and physical properties as tool-resisting steel round bars.

G. Steel Sections: ASTM A236, galvanized after welding typical.

H. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240, austenitic stainless steel, Type 304.

I. Stainless-Steel Bars and Shapes: ASTM A 276, Type 316L

J. Standard Fasteners: Exposed Mechanical Fastenings: Flush countersunk torx or hex socket machine screws and bolts; stainless steel finish; unobtrusively located; consistent with design of component, except where specifically noted otherwise. Fasteners, Bolts, Nuts, and Washers: ASTM A325. All bolts, machine screws and fasteners shall be A316 stainless steel.

K. Concealed Bolts: ASTM A325, A316 stainless unless otherwise indicated.

L. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

M. Stainless Steel Cable: AISI Type 316 stainless steel Aircraft Cable.

2.4 VERTICAL SLIDING DOOR AND HORIZONTAL SLIDING DOOR ASSEMBLIES

N. Manufacturers: Subject to compliance with requirements, available manufacturers offering

O. Touch-up Primer for Galvanized Surfaces: ZRC or approved equal to match color of galvanized panels for all field welded surfaces. Cold galvanizing is intended for limited touch-up only and will be acceptable only for those areas necessary for field welds.

P. Cable: 1/8” diameter, stainless steel aircraft cable composed of 7 strands of 19 wires per strand (7 x 19), 1700 lb. break strength minimum, uncoated, with accessory end fittings as manufactured by Cable Design, Wilmette, Illinois, (847) 256-9813, or approved equal. Routing and length as indicated for proper operation and with associated fittings.

N. Cabled counterweight assemblies: Adjustable counterweight fully contained, except for handle clearance, by steel channels for the length of counterweight travel. Cables

shall be run within galvanized steel sleeves, bent plates, or pipes between sheave assemblies.

O. Non counterweight cable operation assemblies: Fully contained cables run within hot dipped galvanized steel sleeves, bent plates, or pipes between sheave assemblies.

P. Sheaves: Covered assembly with nylon sheaves and accessible bronze bearings for lube required. Wheel shall be fully contained, except for cable entry and exit, in a galvanized steel box with clear 1/4 inch thick polycarbonate removable cover. Removable cover fasteners shall be countersunk, flat head type.

Q. Steel Sections:ASTM A236, galvanized after welding typical

R. Steel/HDPE Doors:

1. Frame: As detailed.
2. Provide HDPE boards attached to frame as detailed.
3. Face panels each side, continuously welded to frame.
4. Provide attached poly door guides in guide tracks to prevent metal to metal contact.
5. Coordinate with operational hardware.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. 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. Coordinate dimensions and attachment methods of detention enclosures with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Form and grind edges and corners to be free of sharp edges or rough areas.

D. Form metal in maximum lengths to minimize joints. Form sheet-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

E. Weld corners and seams continuously to comply with referenced AWS standard and 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. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

5. Obtain fusion without undercut or overlap.
6. Finish exposed welds and surfaces smooth and blended at exposed connections so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
7. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

G. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention enclosures rigidly in place and to support indicated loads. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.

H. Cut, reinforce, drill, and tap detention enclosures as indicated to receive hardware, security fasteners, and similar items.

Q. Form exposed work true to line and level with accurate angles, surfaces, and straight sharp edges.

R. Form exposed connections with hairline joints flush and smooth using concealed fasteners where possible. Use exposed security fasteners of type indicated or, if not indicated, flat-head (countersunk) security screws. Locate joints where least conspicuous.

S. Exterior Caging Enclosures: Allow for thermal movements from ambient and surface temperature changes. 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.

2.6 FERROUS STEEL FINISHES

2.7 DOOR HARDWARE AND KEYING

1. Refer to drawings for design intent

A. Padlocks:

1. Padlocks shall be Best HD Padlock part #22B722TMS. Provide a padlock for every padlock tab lock location indicated on the Drawings and/or as scheduled.
   a. Zoo provides all padlocks; contractor provides core and cylinders.

B. Sliding Door/Gate:

1. Richards Wilcox or approved equal, 232 Series galvanized track/roller assembly and accessories.
   A. Side wall mounting brackets: 0232 center and end blank.
   B. 2321.00003 track.
   C. 2321 truck/apron assembly.
   D. .0572 end stop.
   E. 0514.00038 heavy duty spring bolt.
   F. Remote cable operation typical in both directions from keeper corridor.

C. Vertical Guillotine Door: Provide side channels and fittings as required for remote cable operation in both directions from keeper corridor.

D. Substitutions: All substitutions for the hardware of this Section must be reviewed and approved by the Exhibit Designer and COTR prior to Bid acceptance.

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 caging enclosures.

T. Examine roughing-in for embedded and built-in anchors to verify actual locations of detention enclosure connections before installation.

U. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of caging enclosures.

V. Inspect built-in and cast-in anchor installations, before installing caging enclosures, to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
2. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

W. Verify locations of detention enclosures with those indicated on Shop Drawings.

X. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing caging enclosures to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.

B. Cutting, Fitting, and Placement: Obtain manufacturer's written approval for cutting, drilling, and fitting required for installing caging enclosures. Set caging enclosures accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into adjacent construction.

D. 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.

E. Field Welding: Comply with the following requirements:

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

G. Obtain fusion without undercut or overlap.

H. Remove welding flux immediately.

I. Finish exposed welds and surfaces smooth and blended at exposed connections so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.3 FIELD QUALITY CONTROL

A. COTR shall review installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Remove and replace caging work if inspections indicate that work does not comply with specified requirements. Remove malfunctioning units; replace with new units. All doors, and guillotines shall operate smoothly, quietly, and without binding.

C. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

D. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

3.3 CLEANING AND PROTECTION

A. Clean field welds, bolted connections, and abraded areas.

END OF SECTION 055963

SECTION 061000 - ROUGH CARPENTRY

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. Wood fence planks.

B. Related Requirements:
   1. Section 06 6000 "Plastic Lumber -Animal."
   2. Section 32 3113 Fences and Gates

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 6 inches nominal 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. WCLIB: West Coast Lumber Inspection Bureau.
   4. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the 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, mark grade stamp on end or back of each piece.
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 lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.2 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Fence planks.

B. For items of dimension lumber size, provide Construction or No. 2 and the following species:

1. Cedar; WCLIB or WWPA.
2. Cedar; NLGA.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring**,** nailers, blocking, grounds**,** and similar supports to comply with requirements for attaching other construction.

B. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

C. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced.

1. Comply with approved fastener patterns where applicable. Before fastening, mark fastener locations, using a template made of sheet metal, plastic, or cardboard.
2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 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 rough carpentry from weather. If, despite protection, rough carpentry becomes sufficiently wet that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061753 - SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.

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.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification from treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification from treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to truss fabricator.

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 Submittals: 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. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

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 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:

a. Roof Trusses: Vertical deflection of 1/240 of span.

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."

2.2 WOOD PRODUCTS

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. Provide dressed lumber, S4S.
3. Provide dry lumber with 19 percent maximum moisture content at time of dressing.

B. Permanent Bracing: Provide wood bracing.

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 (Z180) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for interior locations unless otherwise indicated.

C. 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.

D. Nails, Brads, and Staples: ASTM F1667.

2.4 METAL FRAMING ANCHORS AND ACCESSORIES

A. Allowable design loads, as published by manufacturer, are to comply with or exceed those indicated. 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 (Z180) coating designation.

1. Use for interior locations unless otherwise indicated.

C. Truss Tie-Downs: Bent strap tie for fastening roof trusses to wall studs below, 1-1/2 inches (38 mm) wide by 0.050 inch (1.3 mm) thick. Tie fastens to one side of truss, top plates, and side of stud below.

2.5 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

2.6 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.

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.

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 Architect.

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. 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: Owner 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 061753

SECTION 066000 – PLASTIC LUMBER

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Plastic lumber

1.2 RELATED SECTIONS:
   1. Specification section 055000, “Metal Fabrications”.
   2. Specification section 055964, “Metal Welded Mesh Enclosure”.
   3. Specification section 055965, “Vertical Sliding Doors”.
   4. Specification section 088000, “Glazing”.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: plastic lumber in manufacturer’s standard sizes.

1.4 QUALITY ASSURANCE

A. Testing Agency: Acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect plastic lumber from moisture and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 Structural Reinforced High-density Polyethylene (HDPE) Lumber:

A. Basis of Design: Subject to compliance with requirements, provide, or approved equal product.
   A) American Plastic Lumber, Inc.
   B) Structural BM Reinforced Lumber,
   C) Tangent Sustainable Lumber, or approved substitution.

B. Moisture Absorption: .06% by weight

C. Compression Strength Perpendicular to Grain: ASTM D6108

1. 1482 psi

D. Compression Strength Parallel to Grain: ASTM D6108
   1. 2842 psi

E. Thermal Expansion: ASTM D6341-98
   1. 0.000033 (in/in/deg)

F. Shear Strength: ASTM D2344
   1. 800 psi

G. Ultraviolet: ASTM D4329
   1. Less than 10% change in Type D durometer at 500 hrs

H. Flexural Strength: ASTM D6109
   1. 2750 psi

I. Surface-burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.
   1. Flame-spread index: Spread 62 or less; classification 60 or less.
   2. Smoke-developed index: Smoke developed 230 or less; smoke developed classification 250 or less.

J. Nominal Thickness: See drawings.

K. Surface Finish: As selected by COTR-Smithsonian Institute from manufacturer's full range.

L. Color: As selected by COTR-Smithsonian Institute from manufacturer's full range.

2.2 NON-REINFORCED LUMBER

A. Basis of Design: Subject to compliance with requirements, provide American Plastic Lumber, Inc, Premium BM Lumber or approved equal product.

B. Moisture Absorption: .06% by weight
C. Compression Strength Perpendicular to Grain: ASTM D6108
   1. 1482 psi

D. Compression Strength Parallel to Grain: ASTM D6108
   1. 1030 psi

E. Thermal Expansion: ASTM D6341-98

1. 0.000058 (in/in/deg)

F. Ultraviolet: ASTM D4329
   1. Less than 10% change in Type D durometer at 500 hrs

G. Flexural Strength: ASTM D6109
   1. 1350 psi

H. Surface-burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.
   1. Flame-spread index: Spread 62 or less; classification 60 or less.
   2. Smoke-developed index: Smoke developed 230 or less; smoke developed classification 250 or less.

I. Nominal Thickness: See drawings.

J. Surface Finish: As selected by COTR-Smithsonian Institute from manufacturer's full range.

K. Color: As selected by COTR-Smithsonian Institute from manufacturer's full range

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

B. When pre-drilling, oversize holes in order to allow for expansion and contraction according to manufacturer's written recommendations.

3.3 INSTALLATION, GENERAL

A. Install plastic paneling according to manufacturer's written instructions.

END OF SECTION 066000

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Demolition of existing roof drainage system
   2. Roof-drainage sheet metal fabrications.
   3. Miscellaneous sheet metal fabrications.

1.2 COORDINATION

A. Coordinate sheet metal flashing and trim installation with demolition of existing system to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

   1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.4 ACTION SUBMITTALS

A. Product Data:

   1. Roof-drainage sheet metal fabrications.
   2. Miscellaneous sheet metal fabrications.

B. Product Data Submittals:
   1. Elastomeric sealant.

C. Sustainable Design Submittals:
   1. Recycle all metal

D. Shop Drawings: For sheet metal flashing and trim.

   1. Include plans, elevations, sections, and attachment details.
   2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.

3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of edge conditions, including eaves, flashings, and counterflashings.
9. Include details of connections to adjoining work.
10. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches.

E. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

F. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

G. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

B. Special warranty.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
   1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless COTR specifically approves such deviations in writing.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

   1. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to 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 are not to rattle, leak, or loosen, and are to remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown.

C. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawing KS101.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent 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: 120 deg F, ambient; 180 deg F, material surfaces.

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; prepainted by coil-coating process to comply with ASTM A755/A755M.

1. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces, and the inside of the gutter, to comply with coating and resin manufacturers' written instructions.

2. Color: As selected by COTR from manufacturer's full range. Assume one color for gutters and a separate color for downspouts.

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 or manufactured item.

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.

2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane, polysulfide, or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

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.

1. Form expansion joints to maintain water tight assemblies.

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. 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.

G. Do not use graphite pencils to mark metal surfaces.

2.5 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
2. Fabricate in minimum 96-inch-long sections.
3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by SMACNA, but with thickness not less than twice the gutter thickness.
4. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
5. Gutter Profile: SMACNA Style H.
6. Expansion Joints: Lap type.
7. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen.
8. Fabricate Gutters from the following materials:
   a. Galvanized Steel: 0.034 inch thick.

B. Downspouts: Fabricate round downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Hanger Style: Fig. 1-14A in accordance with SMACNA's "Architectural Sheet Metal Manual."
2. Fabricate from Galvanized Steel: 0.022 inch thick.

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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Demolish existing gutters, downspouts and sheet metal trim.
1. Do not begin demolition until all labor and materials are on site for the new systems.
2. Do not demolish more in a day than you can install new, i.e., do not leave the building unprotected by a gutter and downspout system.

B. Install sheet metal flashing and trim to comply with details indicated and SMACNA recommendations.

1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items 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. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
7. Do not field cut sheet metal flashing and trim by torch.
8. Do not use graphite pencils to mark metal surfaces.

C. 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 SMACNA.

D. 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.

E. 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 and not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

F. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors for a tight installation.

G. Seal joints for watertight construction.

1. Use sealant-filled joints.

a. Embed hooked flanges of joint members not less than 1 inch into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.

1) Do not install sealant-type joints at temperatures below 40 deg F.

H. Rivets: Rivet joints where necessary for strength.

3.3 INSTALLATION OF ROOF-DRAINAGE SYSTEM

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with SMACNA. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters:

1. Join sections with joints sealed with sealant.
2. Provide for thermal expansion.
3. Attach gutters at eave or fascia to firmly anchor them in position.
4. Provide end closures and seal watertight with sealant.
5. Slope to downspouts.
6. Fasten gutter spacers to front and back of gutter.
7. Anchor gutter with gutter brackets spaced not more than 24 inches apart to blocking, and loosely lock to front gutter bead.
8. Install gutter with expansion joints not exceeding, 50 feet apart. Install expansion-joint caps.

9. Install continuous gutter screens on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.

C. Downspouts:

1. Join sections with 1-1/2-inch telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches o.c.
4. Connect downspouts to underground drainage system.

3.4 INSTALLATION OF ROOF FLASHINGS

A. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in SMACNA. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

B. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
1. Extend counterflashing 4 inches over base flashing.
2. Lap counterflashing joints minimum of 4 inches.
3. Secure in waterproof manner.

3.5 INSTALLATION OF WALL FLASHINGS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with SMACNA. Coordinate installation of wall flashing with installation of wall-opening components such as louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings.

3.6 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 within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces.

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 COTR.

END OF SECTION 076200

SECTION 081743 - FIBERGLASS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Smooth Fiberglass Doors and Frames.

2. Fire-Rated Fiberglass Door in Fire-Rated Fiberglass Frame.

B. Related Requirements:

1. Section 087100 "DOOR HARDWARE" for hardware to provide on Fiberglass Doors and frames.

2. Section 08 8000 - Glazing

1.2 ACTION SUBMITTALS

A. Product Data: For Doors and Frames. Clearly mark on data sheets which options and features are proposed and mark out options and features not to be included.

B. Shop Drawings:

1. Submit manufacturer’s shop drawings, including elevations, sections, and details indicating dimensions, tolerances, materials, fabrication, doors, panels, framing, hardware schedule, and finish.

C. Samples for Initial Selection:

1. Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.
2. Door sample composed of door face sheet, core, and edge framing.

D. Samples for Verification: Actual sample of finished products for each type of exposed finish.

1. Size: Manufacturers' standard size.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For doors and frames including recommended cleaning methods.

B. Warranty Documentation:

1. Manufacturers' special warranties.
2. Installer's special warranties.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: Continuously engaged in manufacturing of doors of similar type to that specified, with a minimum of 10 years successful experience.
2. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

1.6 Delivery.

1. Deliver materials to site in manufacturer’s original, unopened, containers and packaging.
2. Labels clearly identifying opening, door mark, and manufacturer.

1.7 Storage.

1. Store materials in a clean, dry area, indoors in accordance with manufacturer’s instructions.

1.8 Handling.

1. Protect materials and finish from damage during handling and installation.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fiberglass doors and frames that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including excessive deflection.
b. Faulty operation.
c. Deterioration of materials or finish beyond normal weathering.

2. Warranty Period: Ten year(s) from date of shipment of product to site.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-rated door, panel and frame construction conforms to products tested under ASTM E152, UL10C & NFPA 252. 2.

B. Install doors, panels and frames conforming to NFPA 80 for fire-rated class, ANSI A117.1 specifications for handicap accessibility, ADA requirements,

C. ANSI A250.4-2011 cycle swing in excess of 1,000,000 cycles with no failure of any design features of the door.

D. Flame Spread: All rated FRP component parts, including the finish, shall have a flame spread classification of 25 or less per ASTM E84 and shall be self extinguishing per ASTM D635, unless operating conditions dictate otherwise.

E. Resins and coatings to meet with USDA standards for incidental food contact, if applicable to this project.

F. Pultruded Fiberglass Skin.

1. Surface Burning, ASTM-E84: Flame Spread ≤ 25, Smoke Developed ≤ 450.
2. Tensile Strength, ASTM-D638: 12,300 psi.
3. Percent Fiberglass: 50%.

G. Stiles & Rails.

1. Fastener Withdrawal, ASTM-D1761: 894 lbs.

H. Door Core.

1. Surface Burning, ASTM-E84: Flame Spread ≤ 25, Smoke Developed ≤ 450.
2. Density, ASTM-D1622: 6.0 pcf.
3. Compressive Strength, ASTM-D1621: 139 psi.

2.2 COMPOSITE FIBERGLASS DOORS

A. Products: Subject to compliance with requirements, provide the basis of design product indicated below, or a comparable product by another manufacturer:

B. Basis of Design Product: Corrim Company FRP ‘POLYFIRE’ FIRE DOORS AND FRAMES 250° TEMPERATURE RISE FIBERGLASS FIRE DOORS Door Thickness: 1-3/4”.

C. Construction:

1. Door Core: 6 pound per cubic foot closed-cell polyurethane foam.
2. Door Faces: Four layers of fiberglass reinforcement fully encapsulated with resin on each face.
3. Stile Edges: 9/16” thick solid fiber reinforced plastic (FRP).
4. Top Rail: 6” high FRP with ¼” wall thickness.
5. Bottom Rail: Manufacturer’s standard closed bottom rail.
6. Cut-outs: Provide cut-out at factory for vision lite.
7. Prepare, reinforce, and machine doors for specified hardware at factory.

D. Finish: Integral through color from manufactures standard line.

E. Lite Kits: manufacturer's standard "half lite" framing with trim finished to match door face.

F. Performance requirements:

1. Pultruded Fiberglass Skin.
   a. NFPA 80 rated

   b. Surface Burning, ASTM-E84: Flame Spread ≤ 25, Smoke Developed ≤ 450.
   c. Tensile Strength, ASTM-D638: 12,300 psi.
   d. Percent Fiberglass: 50%.

2. Stiles & Rails.

   a. Fastener Withdrawal, ASTM-D1761: 894 lbs.

3. Door Core.

   a. Surface Burning, ASTM-E84: Flame Spread ≤ 25, Smoke Developed ≤ 450.
   b. Density, ASTM-D1622: 6.0 pcf.
   c. Compressive Strength, ASTM-D1621: 139 psi.

2.3 FIBERGLASS DOOR FRAME

A. Product: Subject to compliance with requirements, provide the basis of design product indicated below, or a comparable product by another manufacturer:
   1. Basis of Design Product: Corrim Company FRP 'POLYFIRE' FIRE DOORS AND FRAMES 250° TEMPERATURE RISE FIBERGLASS FIRE DOORS Door Thickness: 1-3/4".

B. Jamb Depth: As indicated on drawings.

C. Frame Members: ¼" thick pultruded fiberglass with integral stops.

D. Construction: Knocked down for field assembly.

E. Frame Member to Member Connections:

1. Corners mitered with 4" x 4" x 3/8" pultruded FRP angle reinforcement with interlocking pultruded FRP brackets.
2. Provide hairline butt joint appearance.

F. Reinforcements:

1. ¼" thick pultruded FRP chemically welded to frame at all hinge, strike, and closer locations.

G. Hardware:

1. Pre-machine and reinforce frame members for hardware in accordance with manufacturer's standards and door hardware schedule.

H. Surface mounted closers will be reinforced for but not prepped or installed at factory.

I. Anchors:

1. Masonry: Existing concrete or block punch and dimple.

J. Performance Requirements:

1. Tensile Strength, ASTM-D638: 15,900 psi.
2. Tensile Modulus of Elasticity, ASTM-D638: 1.58 x 106 psi.
3. Maximum Compressive Strength, ASTM-D695: 15,500 psi.
4. Fastener Withdrawal, ASTM-D1761: 924 lbs.
5. Percent Fiberglass: 60%.

2.4 FASTENERS:

A. Material: Stainless Steel.

B. Finish: Finish all exposed fasteners to match door surfaces.

2.5 FINISHES

A. Door and Frame: Integral Through Color selected by COTR from manufactures standard pallet

B. 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.

2.6 ACCESSORIES

A. Fiberglass Vision Lite Framing: All fiberglass framing and trim.

B. Glazing: 3/8” (min.) laminated safety glazing

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive doors with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Ensure openings to receive frames are plumb, level, square, and in tolerance.

3.3 INSTALLATION

A. Install doors in accordance with manufacturer's instructions.

B. Install doors plumb, level, square, true to line, and without warp or rack.

C. Anchor frames securely in place.

D. Install exterior doors to be weathertight in closed position.

E. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by COTR.

F. Remove and replace damaged components that cannot be successfully repaired as determined by COTR.

3.4 ADJUSTING

A. Adjust doors and hardware to function smoothly, and lubricate as recommended in writing by manufacturer.

3.5 CLEANING

A. Clean doors promptly after installation in accordance with manufacturer's instructions.

B. Do not use harsh cleaning materials or methods that would damage finish.

3.6 PROTECTION

A. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of substantial completion.

END OF SECTION 081743

SECTION 087111 - DOOR HARDWARE DESCRIPTIVE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

    a. Swinging doors.
    b. Sliding animal doors.
    c. Keeper Doors

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Related Sections:

1. Section 081743 "FPR Doors and Frames" for astragals provided as part of labeled fire-rated assemblies and for door silencers provided.
2. Section 055964 "Metal Welded Mesh Enclosures" for door hardware for doors in wire mesh enclosures

1.3 DOOR HARDWARE ALLOWANCE

A. Furnish door hardware as part of Door Hardware Allowance.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Initial Selection: For plastic protective trim units in each finish, color, and texture required for each type of trim unit indicated.

C. Samples for Verification: For exposed door hardware of each type required, in each finish specified, prepared on Samples of size indicated below. Tag Samples with full description for coordination with the door hardware schedule. Submit Samples before, or concurrent with,

submission of door hardware schedule. Verify locksets for doors, casework and interior Bathroom-Locker Room doors with COTR for suitability.

1. Sample Size: Full-size units or minimum 2-by-4-inch Samples for sheet and 4-inch long Samples for other products.

    a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

D. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

    a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
    b. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
    c. Content: Include the following information:

        1) Identification number, location, hand, fire rating, size, and material of each door and frame.
        2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
        3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
        4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
        5) Fastenings and other pertinent information.
        6) Explanation of abbreviations, symbols, and codes contained in schedule.
        7) Mounting locations for door hardware.
        8) List of related door devices specified in other Sections for each door and frame.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing COTR's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer

B. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

C. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor and COTR about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:

1. For door hardware, an Architectural Hardware Consultant (AHC)

C. Source Limitations: Obtain each type of door hardware from a single manufacturer.

D. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines

1. tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Comply with the following maximum opening-force requirements:

   a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high

4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

F. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to COTR-Smithsonian Institute and Contractor the conference participants shall also include Installer's Architectural Hardware Consultant and COTR's security consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

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.

G. Preinstallation Conference: Conduct conference at Project site

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to COTR-Smithsonian Institute.

1.9 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified elsewhere.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with COTR's security consultant.

D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

a. Manual Closers: 10 years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for COTR's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, provide [six] <Insert number> months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by descriptive titles corresponding to requirements specified in Part 2.

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

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

a. Baldwin Hardware Corporation.
b. Bommer Industries, Inc.
c. Cal-Royal Products, Inc.
d. Hager Companies.
e. IVES Hardware; an Ingersoll-Rand company.
f. Lawrence Hardware Inc.
g. McKinney Products Company; an ASSA ABLOY Group company.
h. PBB, Inc.
i. Stanley Commercial Hardware; Div. of The Stanley Works.

B. Antifriction-Bearing Hinges: Standard

1. Mounting: Full mortise (butts)
2. Bearing Material: Manufacturer's standard antifriction bearing
3. Grade: Grade 1 (heavy weight)
4. Base and Pin Metal:

a. Exterior Hinges: Stainless steel with stainless-steel pin
b. Interior Hinges: Stainless steel with stainless-steel pin.

5. Pins: Nonremovable.

a. Outswinging Exterior Doors: Nonremovable.

b. Outswinging Corridor Doors with Locks: Nonremovable.

6. Tips: Flat button
7. Corners: Square

C. Antifriction-Bearing Hinges: Animal Door

1. Mounting: Full mortise fully welded
2. Bearing Material: Manufacturer's standard antifriction bearing
3. Grade: Grade 1 (heavy weight)
4. Base and Pin Metal:

a. Exterior Hinges: 4 ½ x 4 ½, Stainless steel with stainless-steel pin, 3-knuckle ½" pin min.

5. Pins: Nonremovable.

a. Outswinging Exterior Doors: Nonremovable.
b. Outswinging Corridor Doors with Locks: Nonremovable.

6. Tips: Flat button
7. Corners: Square

2.3 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
2. Deadbolts: Minimum 1-inch throw.

C. Lock Backset: 2-3/4 inches , unless otherwise indicated.

D. Lock Trim:

1. Description: Heavy Duty lever
2. Levers: Cast.
3. Knobs: Cast.
4. Escutcheons : Cast.
5. Dummy Trim: Match knob or lever lock trim and escutcheons.
6. Operating Device: Lever with escutcheons

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

F. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.

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

a. Accurate Lock & Hardware Co.
b. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
c. Arrow USA; an ASSA ABLOY Group company.
d. Best Access Systems; Div. of Stanley Security Solutions, Inc.
e. Cal-Royal Products, Inc.
f. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
g. Falcon Lock; an Ingersoll-Rand company.
h. Marks USA.
i. PDQ Manufacturing.
j. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
k. Schlage Commercial Lock Division; an Ingersoll-Rand company.
l. Yale Security Inc.; an ASSA ABLOY Group company.

G. Mortise Auxiliary Locks: BHMA A156.5; Grade 1; with strike that suits frame.

1. 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. Accurate Lock & Hardware Co.
b. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
c. Arrow USA; an ASSA ABLOY Group company.
d. Best Access Systems; Div. of Stanley Security Solutions, Inc.
e. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
f. Schlage Commercial Lock Division; an Ingersoll-Rand company.
g. Yale Security Inc.; an ASSA ABLOY Group company.

2. Backset: 2-3/4 inches
3. Material: Stainless steel
4. Deadlocks: Deadbolt operated by key outside and turn inside

2.4 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

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. Schlage Commercial Lock Division; an Ingersoll-Rand company. Small format interchangeable cylinders with seven pin cores.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are interchangeable face finished to match lockset.

1. Number of Pins: Seven.
2. Type: Mortise type.

C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.5 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.

1. No Master Key System: Only change keys operate cylinder.
2. Master Key System: Change keys and a master key operate cylinders.
3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.
5. Existing System:

a. Master key or grand master key locks to COTR's existing system.
b. Re-key COTR's existing master key system into new keying system.

6. Keyed Alike: Key all cylinders to same change key.

B. Keys: Nickel silver

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: Information to be furnished by COTR.

2. Quantity: In addition to one extra key blank for each lock, provide the following:

a. Cylinder Change Keys: Three.
b. Master Keys: Five.
c. Grand Master Keys: Five.
d. Great-Grand Master Keys: Five.

2.6 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.5; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.

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 Key Boxes and Cabinets.
b. GE Security, Inc.
c. HPC, Inc.
d. Lund Equipment Co., Inc.
e. MMF Industries.
f. Tri Palm International.

2. Multiple-Drawer Cabinet: Cabinet with drawers equipped with key-holding panels and key envelope storage, and progressive-type ball-bearing suspension slides. Include single cylinder lock to lock all drawers.
3. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.
4. Portable Cabinet: Tray for mounting in file cabinet, equipped with key-holding panels, envelopes, and cross-index system.

B. Key Lock Boxes: Designed for storage of quantity of keys determined by COTR, with tamper switches to connect to intrusion detection system.

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. GE Security, Inc.
b. HPC, Inc.
c. Knox Company.

2.7 OPERATING TRIM

A. Operating Trim: BHMA A156.6; aluminum 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. Burns Manufacturing Incorporated.
b. Don-Jo Mfg., Inc.
c. Forms + Surfaces.
d. Hager Companies.
e. Hiawatha, Inc.

f. IVES Hardware; An Ingersoll-Rand Company.
g. Rockwood Manufacturing Company.
h. Trimco.

B. Flat Push Plates: 0.050 inch thick, 4 inches wide by 16 inches high with square corners and beveled edges; secured with exposed screws.

C. Straight Door Pulls: With minimum clearance of 1-1/2 inches from face of door.

1. Type: 3/4-inch constant-diameter pull.
2. Mounting: Surface applied with concealed fasteners
3. Overall Length: 9 inches

2.8 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Arrow USA; an ASSA ABLOY Group company.
b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
c. DORMA Architectural Hardware; Member of The DORMA Group North America.
d. Dor-O-Matic; an Ingersoll-Rand company.
e. K2 Commercial Hardware; a Black & Decker Corp. company.
f. LCN Closers; an Ingersoll-Rand company.
g. Norton Door Controls; an ASSA ABLOY Group company.
h. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
i. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
j. Yale Security Inc.; an ASSA ABLOY Group company.

B. Cast-Aluminum Surface Closers: Grade 1; Traditional Type with mechanism enclosed in cast-aluminum alloy shell.

1. Mounting: Hinge side
2. Type: Regular arm
3. Backcheck: Factory preset, effective between 60 and 85 degrees of door opening.

2.9 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16; aluminum base metal.

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. Architectural Builders Hardware Mfg., Inc.
    b. Baldwin Hardware Corporation.
    c. Burns Manufacturing Incorporated.
    d. Cal-Royal Products, Inc.
    e. Don-Jo Mfg., Inc.
    f. Door Controls International, Inc.
    g. Hager Companies.
    h. Hiawatha, Inc.
    i. IVES Hardware; an Ingersoll-Rand company.
    j. Rockwood Manufacturing Company.
    k. Stanley Commercial Hardware; Div. of The Stanley Works.
    l. Trimco.

B. Wall Bumpers: Grade 1; with rubber bumper; 2-1/2-inch diameter, minimum 3/4-inch projection from wall; with backplate for concealed fastener installation; with convex bumper configuration.

C. Lever-Type Door Holders: Grade 1; minimum 4-inch long arm that swings up and remains in vertical position; with replaceable rubber tip; for surface-screw application.

2.10 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Hager Companies.
    b. M-D Building Products, Inc.
    c. National Guard Products.
    d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
    e. Reese Enterprises, Inc.
    f. Sealeze; a unit of Jason Incorporated.
    g. Zero International.

B. Adhesive-Backed Perimeter Gasketing: Vinyl bulb gasket material applied to frame rabbet with self-adhesive.

C. Door Sweeps: Neoprene gasket material held in place by flat aluminum housing or flange; surface mounted to face of door with screws.

D. Door Shoes: Vinyl gasket material held in place by aluminum housing; mounted to bottom edge of door with screws.

1. Extended Housing: One side of door.
2. Mounting: Surface mounted on bottom edge of door.

2.11 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening 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. Hager Companies.
b. M-D Building Products, Inc.
c. National Guard Products.
d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
e. Reese Enterprises, Inc.
f. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
g. Sealeze; a unit of Jason Incorporated.
h. Zero International.

B. Saddle Thresholds:

1. Type: Thermal break and fluted top
2. Base Metal: Aluminum

2.12 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. 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. Baldwin Hardware Corporation.
b. Burns Manufacturing Incorporated.
c. Don-Jo Mfg., Inc.
d. Hiawatha, Inc.
e. IPC Door and Wall Protection Systems, Inc.; Div. of InPro Corporation.
f. IVES Hardware; an Ingersoll-Rand company.
g. Pawling Corporation.
h. Rockwood Manufacturing Company.
i. Trimco.

B. Kick Plates: 10 inches high by door width with allowance for frame stops.

C. Mop Plates: 4 inches high by 1 inch less than door width.

2.13 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

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. Baldwin Hardware Corporation.
b. Cal-Royal Products, Inc.
c. Don-Jo Mfg., Inc.
d. Hager Companies.
e. Rockwood Manufacturing Company.
f. Stanley Commercial Hardware; Div. of The Stanley Works.
g. Trimco.

B. Silencers for Metal Door Frames: Grade 1; neoprene or rubber; minimum diameter 1/2 inch fabricated for drilled-in application to frame.

2.14 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by COTR.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

a. Steel Through Bolts: For the following unless door blocking is provided:

1) Surface hinges to doors.
2) Closers to doors and frames.
3) Surface-mounted exit devices.

2. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
3. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.15 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by COTR.
2. Furnish permanent cores to the Smithsonian Institute for installation.

E. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: COTR will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train the Smithsonian Institute’s maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.

3.8 DOOR HARDWARE SCHEDULE

A. HARDWARE GROUPS

1. HW-1: Exterior Animal/Keeper Door

a. 1 ½ pr Heavy Duty Detention Full Mortise Hinges
b. Lockset
c. Deadbolt
d. Gasketing
e. Threshold
f. Wall Stop

2. HW-2: Specialty Caging, Keeper Door Interior

a. 1 ½ pr Butt Hinges
b. Lockset
c. Deadbolt
d. Wall Stop

3. HW-3: Specialty Caging, Keeper Single Exterior Door

a. 1 ½ pr Butt Hinges
b. Lockset
c. Deadbolt

4. HW-4: Specialty Animal Single Sliding Door

a. Heavy Duty head & Sill Slider Track: Richard Wilcox
b. RW Brackets
c. RW Joint Bracket(s)
d. End blinds
e. RW Pair hangers
f. Guide Roller Strip for Sill Slider Track with Bumper Shoes and Stay Roller
g. Door Stop
h. Remotely Operated w/cable from Care Hall

5. HW-5: Storage Door

a. 1 ½ pr Butt Hinges
b. Storage Lockset
c. Wall Stop
d. Kickplate

6. HW-6: Specialty Caging, Keeper/Animal Double Door Swing

a. 1 ½ pr Heavy Duty Detention Full Mortise Hinges
b. Lockset
c. Deadbolt
d. Single action lever Cane Bolt top and bottom both leaves

7. HW-7: Specialty Caging, Keeper/Animal Single Door Swing

a. 1 ½ pr Heavy Duty Detention Full Mortise Hinges
b. Lockset
c. Deadbolt

8. HW-8: Update Existing Lockset
a. Lockset: HES Innovations 1500 Series Low Profile Electrical strike, coordinate with COTR on power to door

9. HW-9: Update Existing Lockset
a. Lockset: HES Innovations 1600 Series Low Profile Electrical strike, coordinate with COTR on power to door

END OF SECTION 087111

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.

B. Related Sections:

1. Section 081743 “FRP Doors and Frames.”

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Retain one of first two subparagraphs below, usually first. The IBC requires that design wind pressures used for design of exterior components and cladding not designed by the registered design professional be shown on the Construction Documents.

1. Design Wind Pressures: Per jurisdictional code.
2. Retain first subparagraph below if sloped glazing is exposed to snow loads. The IBC requires that the flat-roof snow load be indicated on the Construction Documents if the ground snow load exceeds 10 lbf/sq. ft.
3. Design Snow Loads: Per DCBC Figure 1608.2, minimum 25 psf plus drifting or 30 psf equivalent uniform load, whichever is greater.

4. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
5. Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass to resist each of the following combinations of loads:

    a. Outward design wind pressure minus the weight of the glass. Base design on glass type factors for short-duration load.
    b. Inward design wind pressure plus the weight of the glass plus half of the design snow load. Base design on glass type factors for short-duration load.
    c. Half of the inward design wind pressure plus the weight of the glass plus the design snow load. Base design on glass type factors for long-duration load.

6. Glass Type Factors for Wired, Patterned, and Sandblasted Glass:

    a. Short-Duration Glass Type Factor for Wired Glass: 0.5.
    b. Long-Duration Glass Type Factor for Wired Glass: 0.3.
    c. Short-Duration Glass Type Factor for Sandblasted Glass: 0.5.

7. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.

8. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.

9. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

    1. Temperature Change: 120 deg F, ambient; material surfaces.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

    1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.6 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.
B. Glass Samples: For each type of glass product other than clear monolithic vision glass the following products; 12 inches square.

    1. Tinted glass.
    2. Coated glass.

3. Wired glass.
4. Fire-resistive glazing products.
5. Fully tempered.
6. Insulating glass.

C. Glazing Accessory Samples: For gaskets sealants and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
D. Glazing Schedule: List glass types and thicknesses for each size opening and location.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installers glass testing agency and sealant testing agency.

B. Product Certificates: For glass and glazing products, from manufacturer.
C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for tinted glass coated glass insulating glass glazing sealants and glazing gaskets.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.
E. Warranties: Sample of special warranties.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1. NACC, AG&M, AGMT, with 5 years of experience.
2. Written references to demonstrate successful completion of similar projects.
3. Formal safety program documents in writing.
4. Formal Quality Manual.
5. Resumé and qualifications for quality manager.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
E. Source Limitations for Glass: Obtain ultraclear float glass, tinted float glass, coated float glass and insulating glass from single source from single manufacturer for each glass type.

F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

I. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F, and the fire-resistance rating in minutes.

J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.11 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than **6.0** mm.

2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes **basic** protection testing requirements in ASTM E 1996 for Wind Zone 1 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.

1. Large-Missile Test: For glazing located within 30 feet of grade.
2. Small-Missile Test: For glazing located more than 30 feet above grade.
3. Large-Missile Test: For all glazing, regardless of height above grade.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 1/4-inch
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For uncoated glass, comply with requirements for Condition A.
3. For coated vision glass, comply with requirements for Condition C (other coated glass).

C. Uncoated Tinted Float Glass: Class 2, complying with other requirements specified.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Pilkington, Tint Optifloat, or comparable product by one of the following:

   a. Guardian
   b. Cardinal

2. Tint Color: Bronze, Green
3. Insert performance properties in subparagraph below to suit product(s) selected.
4. Visible Light Transmittance: 76 percent minimum.

D. Polished Wired Glass: ASTM C 1036, Type II, Class 1 (clear), Form 1, Quality-Q6, complying with ANSI Z97.1, Class C.

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

   a. TGP, Wirelite

2. Mesh: M2 (square).

E. Film-Faced Polished Wired Glass: ASTM C 1036, Type II, Class 1 (clear), Form 1, Quality-Q6

2.3 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

B. Windborne-Debris-Impact-Resistant Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, with "Windborne-Debris-Impact Resistance" Paragraph in "Glass Products, General" Article, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with one of the following to comply with interlayer manufacturer's written recommendations:

   a. Polyvinyl butyral interlayer.
   b. Polyvinyl butyral interlayers reinforced with polyethylene terephthalate film.

2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article.

2.4 INSULATING GLASS

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. Guardian Glass of North America.
2. Cardinal Glass Industries
3. Pilkington USA

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Sealing System: Dual seal, with manufacturer's standard**,** primary and secondary.

2. Spacer: Aluminum with bent corners, weld or soldered, filled with dessicant.

3. Desiccant: Molecular sieve or silica gel, or blend of both.

C. Glass: Comply with applicable requirements in "Glass Products" Article and in "Laminated Glass" Article as indicated by designations in "Insulating-Glass Types" Article and in "Insulating-Laminated-Glass Types" Article.

2.5 FIRE-PROTECTION-RATED GLAZING

A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies**.**

B. Fire-Protection-Rated Tempered Glass: 1/4-inch thick, fire-protection-rated tempered glass, complying with testing requirements in 16 CFR 1201 for Category II materials.

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

a. InterEdge, Inc., a subsidiary of AFG Industries, Inc.; PyroEdge-20.
b. Safti First; SuperLite20.
c. Vetrotech Saint-Gobain; SSG Pyroswiss.

C. Fire-Protection-Rated Laminated Glass: 5/16-inch thick, fire-protection-rated laminated glass, complying with testing requirements in 16 CFR 1201 for Category II materials.

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

a. Oldcastle Glass, Inc.; Pyroguard.

D. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, clear float glass; with intumescent interlayers; complying with testing requirements in 16 CFR 1201 for Category II materials.

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

a. InterEdge, Inc., a subsidiary of AFG Industries, Inc.; Pyrobel.
b. Pilkington Group Limited (distributed by Technical Glass Products); PyroStop.
c. Vetrotech Saint-Gobain; SGG Contraflam N2, SGG Swissflam N2.

E. Gel-Filled, Double Glazing Units: Double glazing units made from two lites of uncoated, clear, fully tempered float glass; with a perimeter metal spacer separating lites and dual-edge seal enclosing a cavity filled with clear, fully transparent, heat-absorbing gel; complying with testing requirements in 16 CFR 1201 for Category II materials.

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

a. Safti First; SuperLite II.

2.6 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

4. Sealants used inside the weatherproofing system 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."
5. Colors of Exposed Glazing Sealants: As selected by COTR-Smithsonian Institute from manufacturer's full range.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
G. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.
G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.8 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 80 00

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed extruded-aluminum louvers.

1.2 DEFINITIONS

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

B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).

C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

D. Windborne-Debris-Impact-Resistant Louver: Louver that provides specified windborne-debris-impact resistance, as determined by testing in accordance with AMCA 540.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For manufacturer's special warranties.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.6 WARRANTY

A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures are considered to act normal to the face of the building.

1. Wind Loads:

a. Determine loads based on pressures as indicated on Drawings.

B. Windborne-Debris-Impact Resistance: Louvers located within 30 feet of grade pass basic protection, when tested in accordance with AMCA 540.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width in accordance with AMCA 500-L.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Drainable-Blade Louver, Extruded Aluminum: L-1 and L-2

1. Manufacturers:

a. Basis of Design Product: Ruskin ELF 6350DMP; Air Distribution Technologies, Inc.
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) Airline Louvers; Mestek, Inc.
2) Architectural Louvers Co.; Harray, LLC.
3) Greenheck Fan Corporation.

2. Louver Depth: 6 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
4. Mullion Type: Exposed.
5. Provide sill flashing. Refer to detail for louver placement in wall.
6. Louver Performance Ratings:

a. Free Area: Not less than 0.34 sq. ft. for 12-inch-wide by 12-inch-high louver.
b. Point of Beginning Water Penetration: Not less than 873 fpm.
c. Air Performance: As indicated by manufacturer for product specified.

7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with stainless steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Non-rewirable, U-shaped frames.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening, Stainless Steel: 1/2-inch-square mesh, 0.047-inch wire.
2. Bird Screening, Flattened, Expanded Aluminum: 3/4 by 0.050 inch thick.

2.5 MATERIALS

A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers.

D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless steel components, with allowable load or strength design capacities calculated in accordance with ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing in accordance with ASTM E488/E488M conducted by a qualified testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing to produce uniform appearance.

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

1. Frame Type: Channel unless otherwise indicated.

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

E. Provide subsills and sill flashing made of same material as louvers for recessed louvers.

F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.7 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

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

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

E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

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

Delete subparagraph below if not using factory-applied finish coatings.

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

END OF SECTION 089119

SECTION 099113 - 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.

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 each type of topcoat product.

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

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: 1 gal. of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. The COTR will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical Surfaces: Provide samples of at least 100 sq. ft..

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by COTR at no added cost to the Smithsonian Institution.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless the COTR specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 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: Prior to the selection of a Manufacturer verify with the COTR if there is a current paint manufacturer/brand being used at the NZP, if so that will be the basis of Design. If not subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. PPG Paints; PPG Industries, Inc.
3. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
4. Sherwin-Williams Company (The).

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. Colors: As selected by COTR from manufacturer's full range.

1. 30 percent of surface area will be painted with deep tones.

2.3 PRIMERS

A. 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.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Benjamin Moore & Co.
b. PPG Paints; PPG Industries, Inc.
c. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
d. Sherwin-Williams Company (The).

B. Exterior, Alkyd/Oil Wood Primer: Alkyd/oil-based primer that is resistant to extractive bleeding when applied to wood substrates with less than 15 percent moisture content; formulated for sag, mold, and microbial resistance; for hiding stains; and for use on exterior wood subject to extractive bleeding.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Benjamin Moore & Co.
b. PPG Paints; PPG Industries, Inc.
c. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
d. Sherwin-Williams Company (The).

C. Water-Based Bonding Primer: Pigmented, water-based-emulsion primer formulated for exterior use and to promote adhesion of subsequent specified coatings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Benjamin Moore & Co.
b. PPG Paints; PPG Industries, Inc.
c. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
d. Sherwin-Williams Company (The).

D. Water-Based, Galvanized-Metal Primer: Corrosion-resistant, pigmented, acrylic primer; formulated for use on cleaned/etched, exterior, galvanized metal to prepare it for subsequent water-based coatings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Benjamin Moore & Co.
b. PPG Paints; PPG Industries, Inc.
c. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
d. Sherwin-Williams Company (The).

2.4 FINISH COATINGS

A. Exterior Latex Paint, Low Sheen: Water-based, pigmented coating; formulated for alkali, mold, microbial, and water resistance and for use on exterior surfaces, such as primed wood.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Benjamin Moore & Co.
b. PPG Paints; PPG Industries, Inc.
c. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.

d. Sherwin-Williams Company (The).

2. Gloss and Sheen Level: Manufacturer's standard low-sheen finish.

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, louvers, cameras, 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. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

E. Previously painted 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. Scrape and sand surfaces, remove all loose materials back to a sound and clean substraight. free of any foreign materials and sanding dust.
3. Prime edges, ends, and faces, 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. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. 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. 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 to view:

a. Equipment, including panelboards.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: The Smithsonian Institution may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

3.5 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 The Smithsonian Institution.
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 the COTR, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Galvanized-Metal Substrates:

1. Water-Based, Light Industrial Coating System:

a. Prime Coat: Water-based, galvanized-metal primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior, water-based, light industrial coating, low sheen [**gloss**].

B. Dressed-Lumber Substrates: Trim Architectural woodwork Doors Windows Board siding.

1. Latex over Latex Primer System:

   a. Prime Coat: Exterior, latex wood primer.
   b. Intermediate Coat: Matching topcoat.
   c. Topcoat: Exterior latex paint, low sheen.

2. Latex over Alkyd Primer System:

   a. Prime Coat: Exterior, alkyd/oil wood primer.
   b. Intermediate Coat: Matching topcoat.
   c. Topcoat: Exterior latex paint, low sheen.

3. Alkyd System:

   a. Prime Coat: Exterior, alkyd/oil wood primer.
   b. Intermediate Coat: Matching topcoat.
   c. Topcoat: Exterior alkyd enamel, semigloss.

END OF SECTION 099113

SECTION 099123 - 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 surface preparation and the application of paint systems on interior substrates.

1. Concrete.
2. Concrete masonry units (CMU).
3. Wood.
4. Gypsum board.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
2. Section 099600 "High-Performance Metals (Animal Areas)" for high-performance and special-use coatings.
3. Section 099611 "High-Performance (Proprietary Misc. Metals)" for surface preparation and the application of paint systems on exterior substrates.

1.3 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 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint 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 proposed product highlighted.
3. VOC content.

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. Paint: 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. COTR will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
b. Other Items: COTR will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by COTR at no added cost to COTR-Smithsonian Institute.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless COTR specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. McCormick Paints: BOD

2. Behr Process Corporation.
3. Benjamin Moore & Co.
4. Benjamin Moore & Co. (Canada).
5. Bennette Paint Manufacturing Company, Inc.
6. Betonel Ltd.
7. BLP Mobile Paint Manufacturing.
8. California Paints.
9. Cloverdale Paint.
10. Color Wheel Paints & Coatings.
11. Columbia Paint & Coatings.
12. Conco Paints.

13. Coronado Paint.
14. Davis Paint Company.
15. Diamond Vogel Paints.
16. Dunn-Edwards Corporation.
17. Durant Performance Coatings.
18. Duron, Inc.
19. Envirocoatings Canada Inc.
20. Euclid Chemical Company.
21. Farrell-Calhoun.
22. Frazee Paint.
23. General Paint.
24. Hallman Lindsay Paints.
25. Hirshfield's, Inc.
26. ICI Paints.
27. ICI Paints (Canada).
28. Insl-x.
29. Kelly-Moore Paints.
30. Kwal Paint.
31. M.A.B. Paints.
32. Microblend Technologies Inc.
33. Miller Paint.
34. Mills Paint.
35. PARA Paints.
36. Parex LaHabra Inc.
37. Parker Paint Mfg. Co. Inc.
38. PPG Architectural Finishes, Inc.
39. Pratt & Lambert.
40. Rodda Paint Co.
41. Scott Paint.
42. Sherwin-Williams Company (The).
43. Sico, Inc.
44. Southern Diversified Products, LLC.
45. Smith Paint Products.
46. Vista Paint.
47. Zinsser.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. 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 manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

D. Low-Emitting Materials: Interior paints and coatings 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. Colors: As selected by COTR from manufacturer's full range

1. 10 percent of surface area will be painted with deep tones.

2.3 BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior: (PT-1)

B. Block Filler, Epoxy, Interior: (PT-2)

C. Block Filler, Alkyd, Interior:
1. Ultra Spec Masonry Interior/Exterior Hi-Build Filler

2.4 PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior: (PT-1)

B. Primer, Epoxy, for Interior: (PT-2)

C. Primer, Alkyd, for Interior:

2.5 METAL PRIMERS

A. Primer, Rust-Inhibitive, Water Based:

2.6 WATER-BASED PAINTS

A. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 2): (PT-1)

B. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 3): (PT-1)

C. Interior/Exterior Acrylic Epoxy, Semi-Gloss: (PT-2)

D. Enamel, Interior, Semi-Gloss (Gloss Level 5):

2.7 CONCRETE/CONCRETE BLOCK COATINGS

A. Clear Sealers, Interior, Exposed Concrete Block Walls & Curbs

2.8 FLOOR COATINGS

A. Stain, Interior, for Concrete Floors:

1. See Section 033000 for Concrete Floor Stain.

B. Sealer, Water Based, for Concrete Floors:

1. See Section 033000 for Concrete Floor Sealer.

C. Sealer, Epoxy, for Concrete Floors:

1. See Section 033000 for Epoxy Concrete Floor Sealer.

2.9 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: COTR-Smithsonian Institute reserves the right to invoke the following procedure:

1. COTR-Smithsonian Institute will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint 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. COTR-Smithsonian Institute may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (CMU): 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.

Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

C. Verify suitability of substrates, including surface conditions and compatibility with existing 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 and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

J. 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.

K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but 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.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

a. Equipment, including panelboards and switch gear.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.
h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:

a. Equipment, including panelboards.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
h. Other items as directed by COTR.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: COTR-Smithsonian Institute may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by COTR, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System:

   a. Prime Coat: Primer sealer, latex, interior
   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior, (Gloss Level 2)

B. Concrete Substrates, Traffic Surfaces:
   a. See Section 033000

C. CMU Substrates:

1. Latex System:

   a. Block Filler: Block filler, latex, interior/exterior
   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior, (Gloss Level 3, 5 (at graphics))

2. Epoxy System:

   a. Block Filler: Block filler, Epoxy, interior/exterior
   b. Intermediate Coat: Epoxy Primer, interior, matching topcoat.
   c. Topcoat: Epoxy, interior, (Gloss Level 3)

3. Graphics Walls:

    a. Block Filler: Block filler, Alkyd, interior/exterior
    b. Intermediate Coat: Alkyd Primer, interior, matching topcoat.
    c. Topcoat: Alkyd, interior, (Gloss Level 5)

D. Steel Substrates:

1. Water-Based Light Industrial Coating System:

    a. Prime Coat: Primer, rust-inhibitive, water based
    b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3)

E. Wood Substrates: Including wood trim, architectural woodwork, doors, windows, wood casework, wood-based panel products glued-laminated construction, exposed joists, & exposed beams.

1. Latex System: Painted

    a. Prime Coat: Primer, latex, for interior wood
    b. Intermediate Coat: Latex, interior, matching topcoat.
    c. Topcoat: Latex, interior, (Gloss Level 3)

2. Polyurethane System: Clear Sealed

    a. Prime Coat: Polyurethane interior, Satin
    b. Top Coat: Polyurethane interior, Satin(Gloss Level 5 at graphics areas)

F. Gypsum Board Substrates:

1. Latex System:

    a. Prime Coat: Primer sealer, latex, interior
    b. Intermediate Coat: Latex, interior, matching topcoat.
    c. Topcoat: Latex, interior, (Gloss Level 3)

2. Epoxy System:

    a. Prime Coat: Epoxy Primer, interior/exterior
    b. Intermediate Coat: Epoxy, interior, matching topcoat.
    c. Topcoat: Epoxy, interior, (Gloss Level 3)

3. Graphics Walls:

    a. Prime Coat: Alkyd Primer, interior/exterior
    b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior, (Gloss Level 5)

G. Cotton or Canvas and ASJ Insulation-Covering Substrates: Including pipe and duct coverings

1. Aluminum Paint System:

a. Prime Coat: Primer sealer, latex, interior
b. Intermediate Coat: Aluminum paint
c. Topcoat: Aluminum paint

END OF SECTION 09 91 23

SECTION 099600 – HIGH-PERFORMANCE COATINGS - METALS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes surface preparations and field application of high-performance coating systems to items and surfaces only as noted in the Finish Schedule & General Notes.

B. Related Sections include the following:

1. Section 05 5000 Metal Fabrications
2. Section 05 5964 - Metal Welded Mesh Enclosures
3. Section 32 3213 – Fences and Gates

1.2 DEFINITIONS

A. Standard coating terms defined in ASTM D 16 apply to this Section.

B. Gloss ranges used in this Section include the following:

1. Semigloss refers to a medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.

C. Environments: The following terms are used in Part 2 of this Section to distinguish between corrosive exposures:

1. “Mild environments” are industrial atmospheres with normal exposure to moderate humidity and condensation, occasional mold and mildew development, and infrequent cleaning with strong chemicals. Environments with low levels of mild chemical fumes and occasional splashing and spilling of chemical products are mild environments.

1.3 SUBMITTALS

A. Product Data: For each coating system indicated. Include primers.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference the specific coating, finish system, and application. Identify each material by manufacturer’s catalog number and general classification.

2. Manufacturer’s Information: Manufacturer’s technical information, including label analysis and instructions for handling, storing, and applying each material specified.

B. Certification by manufacturer that products supplied comply with requirements indicated that limit the amount of VOCs in coating products.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

1. After color selection, Architect will furnish color chips for surfaces to be coated.

D. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, or representative samples of the actual substrate.

1. Provide stepped Samples defining each separate coat, primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.

2. List of material and application for each coat for each sample. Label each sample for location and application.

3. Submit (6) 8-1/2" x 11" draw downs.

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

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed high-performance coating system applications similar in material and extent to those indicated for Project and whose work has a record of successful in-service performance.

B. Source Limitations: Obtain primers and undercoat materials for each coating system from the same manufacturer as the finish coats.

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required. Duplicate finish of approved sample Submittals:

1. Final approval of colors will be from benchmark samples.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label with the following information:

1. Name of 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. Handling instructions and precautions.

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 materials 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 applying coating.

1.6 PROJECT CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 45 and 95 deg F (3 deg C).

B. Do not apply coatings in snow, rain, fog, or mist; 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.

1. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with or continuing coating operation.

2. Work may continue during inclement weather only if areas and surfaces to be coated are enclosed and temperature within the area can be maintained within limits specified by manufacturer during application and drying periods.

1.7 EXTRA MATERIALS

A. Furnish extra high-performance coating materials from the same production run as materials applied and in quantities described below. Package coating materials in unopened, factory-sealed containers for storage and identify with labels describing contents.

1. Quantity: Furnish extra coating materials in quantities indicated below:

a. Semigloss, Polyamide Epoxy Coatings: One 2-gallon kit of each color applied.

2. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.785 L) or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, manufacturers and products that may be incorporated into the Work include, but are not limited to, products indicated in the coating system descriptions.

B. Manufacturer's Name: The following manufacturers are referred to in the coating system descriptions by shortened versions of their names shown in parenthesis:

1. Tnemec Company, Inc. (Tnemec).
2. Approved substitution coating systems will be considered only if in compliance with the specified performance criteria herein.

2.2 COATINGS MATERIALS, GENERAL

A. Material Compatibility: Provide primers, undercoats, and finish-coat materials 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.

B. Material Quality: Provide manufacturer's highest grade of various high-performance coatings specified. Materials not displaying manufacturer's product identification are not acceptable.

C. VOC Classification: Provide high-performance coating materials, including primers, undercoats, and finish-coat materials, that have a VOC classification of 450 g/L or less.

2.3 COLORS

A. Colors: as selected by Architect.

2.4 EXTERIOR HIGH-PERFORMANCE COATING SYSTEMS

A. Refer to drawings and finish schedule for scope.

B. Ferrous Metal: Provide the following finish systems over intermediate coat and primer.

1. Mild Environment (Semigloss Finish): One finish coat over an intermediate coat and a primer.

a. Primer: Zinc Rich primer, shop applied: Tnemec: Series 90-97 Tneme-Zinc.

b. Intermediate Coat: Semigloss acrylic enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 4.0 mils.

1) Tnemec: Series N-69 Hi-Build Epoxoline II.

c. Topcoat: Semigloss acrylic enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 4.0 mils.

1) Tnemec: Series 1075 Endura Shield II. Color: as selected by Architect.

C. Steel Doors: Provide the following finish systems over exterior steel doors and frames.

1. Mild Environment (Semigloss Finish): One finish coat over a primer.

a. Primer: Zinc Rich primer, shop applied: Tnemec: Series 90-97 Tneme-Zinc.

b. Intermediate Coat: Semigloss acrylic enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 4.0 mils.

1) Tnemec: Series 1075 Endura Shield II. Color: as selected by Architect.

D. Galvanized Ferrous Metal

1. Mild Environment (Semigloss Finish): One finish coat over an intermediate coat and primer.

a. Primer: Expoxy/Polyurethane.

1) Tnemec: Series 27 Typoxy, field applied at a spreading rate recommended by manufacturer to achieve a dry film thickness of 3.0 to 5.0 mils.

b. Topcoat: Series 73, Endura Shield Semigloss Polyurethane applied at spreading rate recommended by Manufacturer to achieve a dry film thickness of 2.0 to 3.0 mils.

1) Color: as selected by Architect.

2.6 EXPOSED METAL

A. All exposed metal (exposed to exterior atmosphere), not galvanized, or pre-finished, shall be coated as per this Section.

PART 3 – EXECUTION

3.1 EXAMINATION

A. With applicator present, examine substrates and conditions under which high-performance coatings will be applied, for compliance with coating application requirements.

1. Applying coatings only after unsatisfactory conditions have been corrected and surfaces to receive coatings are thoroughly dry.
2. Start of application is construed as Applicator’s acceptance of surfaces within that particular area.

B. Coordination of Work: Review other Sections in which primers or other coatings are provided to ensure compatibility of total systems for various substrates. On request, furnish information on characteristics of specified finish materials to ensure compatible primers.

1. If a potential incompatibility of primers applied to other exists, obtain the following from the primer Applicator before proceeding.

   a. Confirmation of primer's suitability for expected service conditions.
   b. Confirmation of primer's ability to be top coated with materials specified.

2. Notify Architect about anticipated problems before using the coatings specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size and weight of item, provide surface-applied protection before surface preparation and coating. Mask fire rating labels and remove masking when work is complete.

   1. After completing coating operations, reinstall items that were removed, use workers skilled in the trades involved.

B. Cleaning: Before applying high-performance coatings, clean substrates of substances that could impair bond of coatings. Remove oil and grease before cleaning.

   1. Schedule cleaning and coating application so dust and other contaminates from cleaning process will not fall on wet, newly coated surfaces.

C. Surface Preparation: Clean and prepare surfaces to be coated according to manufacturer's written instructions for each substrate condition as specified.

   1. Provide barrier coats over incompatible primers or remove primers and reprime substrate.

   2. Ferrous-Metal Substrates: Clean ungalvanized ferrous-metal surfaces that have been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC recommendations.

      a. Treat bare and sandblasted or pickled clean metal treatment wash coat before priming.

      b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, solvent clean, and touch up with the same primer as the top coat.

D. Material Preparation: Carefully mix and prepare coating materials according to manufacturer's written instructions.

   1. Maintain containers used in mixing and applying coatings in a clean condition, free of foreign materials and residue.

2. Stir materials before applying to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into the material. Remove film and, if necessary, strain coating material before using.

3. Use only the type of thinners approved by manufacturer and only within recommended limits.

3.3 APPLICATION

A. General: Apply high-performance coatings according to manufacturer's written instructions.

1. Use applicators and techniques best suited for the materials being applied.

2. Do not apply high-performance coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to forming a durable coating film.

3. Coating colors, surface treatments, and finishes are indicated in the coating system description.

4. Provide finish coats compatible with primers used.

5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, grilles, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.

    a. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.

    b. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Scheduling Coating: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required is the is the same regardless of application method.

    a. Omit primer on metal surfaces that have been shop primed and touchup painted.

    b. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.

c. Where manufacturer's written instructions require sanding, sand between applications to produce a smooth, even surface.

d. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until coating has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure and application of another coat does not cause undercoat to lift or lose adhesion.

2. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform finish, color, and appearance. Give special attention to edges, corners, crevices, welds, exposed fasteners, and similar surfaces to ensure that they receive a dry film thickness equivalent to that of flat surfaces.

C. Application Procedures: Apply coatings by brush, roller, spray, or other applicators according to a manufacturer's written instructions.

1. Brush Application: Use brushes best suited for material applied and of appropriate size for the surface item being coated.

a. Apply primers and first coats by brush/roller.

b. Brush out and work brush coats into surfaces in an even film.

c. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.

2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by manufacturer for the material and texture required.

3. Spray Equipment: Use mechanical methods to apply coating if permitted by manufacturer's written instructions and governing regulations.

a. Use spray equipment with orifice size recommended by manufacturer for material and texture required.

b. Apply each coat to provide the equivalent hiding of brush-applied coats.

c. Do not double back with spray equipment building-up film thickness of two coats in one pass, unless recommended by manufacturer.

D. Minimum Coating Thickness: Apply each material no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by manufacturer, to material required to be coated or finished that has not been prime coated by others.

1. Recoat primed and sealed substrates if there is evidence of suction spots or unsealed areas in first coat, to ensure a finish coat with no burn-through or other defects caused by insufficient sealing.

F. Completed Work: Match approved Samples for color, texture, and coverage. Remove, refinish, or recoat work that does not comply with specified requirements.

3.4 FIELD QUALITY CONTROL

A. Owner reserved the right to invoke the following procedures at any time and as often as Owner deems necessary during the period when coatings are being applied:

1. Owner will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will perform appropriate tests for the following characteristics as required by Owner:

a. Quantitative material analysis.
b. Absorption.
c. Accelerated weathering.
d. Accelerated yellowness.
e. Color retention.
f. Alkali and mildew resistance.
g. Abrasion resistance.
h. Apparent reflectivity.
i. Washability.
j. Dry opacity.
k. Recoating.
l. Skinning.

3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. If necessary, Contractor may be required to remove rejected materials from previously coated surfaces if, on recoating with specified materials, the two coatings are not compatible.

3.5 CLEANING

A. Cleanup: at end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether being coated or not, against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

1. Provide “Wet Paint” sign to protect newly coated finished. After completing coating operations, remove temporary protective wrappings provided by others to protect their work.

2. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

END OF SECTION 099600

SECTION 099611 - HIGH-PERFORMANCE COATINGS (PROPRIETARY MISC METALS)

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 surface preparation and application of high-performance coating systems on the following substrates:

1. Exterior Substrates:
   a. Galvanized steel.

2. Interior Substrates:
   a. Galvanized steel.

B. Related Requirements:

1. Section 055000 Metal Fabrications
2. Section 099123 "Interior Painting" for general field painting.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, include preparation requirements and application instructions.

1. Indicate VOC content.

B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

1. Submit Samples on actual substrate material to be coated, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Use same designations indicated on Drawings and in Exterior High-Performance Coating Schedule and Interior High-Performance Coating Schedule. Include color designations and product runs (batch numbers).

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, (batch number) that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 1 gal. of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. COTR will select one surface to represent surfaces and conditions for application of the coating system.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by COTR at no added cost to the Smithsonian Institution.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless COTR specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 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 coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F, or as recommend by the Manufacturer.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Dupont

2.2 HIGH-PERFORMANCE COATINGS

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.
3. Products shall be of same manufacturer for each coat in a coating system.

B. Colors: As selected by COTR from manufacturer's full range. Not more than four deep tone colors.

2.3 EPOXY COATINGS

A. Epoxy, Semigloss: Solvent-based, two-component, epoxy coating; formulated for resistance to incidental splash and spillage of dilute (5 percent) sulfuric acid, (15 percent) hydrochloric acid, (20 percent) sodium hydroxide, gasoline, and heavy-duty cleaners and detergents; for use on wall and floor surfaces in moderate to heavy traffic commercial and moderate industrial environments.
1. Gloss Level: Manufacturer's standard semigloss finish.

B. High-Build Epoxy, Low Gloss: Two-component epoxy, high-solids, low-gloss coating for use on interior or exterior galvinized metal surfaces.
1. Gloss Level: Manufacturer's standard semigloss finish.

C. Basis of Design - Interior and Exterior Epoxy System
1. Primer: Dupont, Corlar, 2 part epoxy
2. Top Coat: Dupont Imron

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. 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 coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted.

1. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed.
3. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, 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 coating systems indicated.

D. Galvanized-Steel Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.3 APPLICATION

A. Apply high-performance coatings in accordance with manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: The Smithsonian Institution may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written instructions, Pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

A. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

B. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by COTR, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Galvanized-Steel Substrates:

1. Epoxy System:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, semigloss.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Galvanized-Steel Substrates:

1. Epoxy over Epoxy Primer System:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, semigloss.

END OF SECTION 099611

SECTION 220101 - PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for all plumbing work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers.

B. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 22.

B. Visit the site and study all aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of all labor, equipment and materials, and the performance of all operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for, including all necessary signatures and paperwork, all permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Owner.

E. Plumbing work of this project includes, as a brief general description, the following:

1. Demolition and installation of frost proof wall hydrant.

F. See Division 01 for requirements related to limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 22 specifications.

B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for all coordination and additional costs as specified in the article "Substitutions," below for substitutions.

C. Products specified by reference standards or by description only: Any product meeting those standards or description.

D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance.

1. Where other acceptable manufacturers are named, Contractor may provide products of those named manufacturers only, which meet the specifications.
2. Where specification permits "equal" products, without naming other acceptable manufacturers, Contractor may use products of any manufacturer, which meet the specifications.

E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 22 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.

3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project, and of representative manufacturer. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. All equipment, construction and installation must meet requirements of local, state and federal governing codes.

C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

1. Furnish: Supply item
2. Install: Mount and connect item
3. Provide: Furnish and install.

E. All materials and equipment shall be installed and completed in a first class and workmanlike manner and in accordance with the best modern methods, practice and manufacturers' instructions. Any work which shall not present an orderly and neat or workmanlike appearance shall be removed and replaced with satisfactory work when so directed in writing by the Architect.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall workmanship.

G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the Architect will determine sizes to be utilized.

H. In all cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the Architect of said uncertainty, doubt, or conflict and obtain a decision as to the intent before starting any work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the Architect and await a written decision.

B. Plan and coordinate all work to proceed in an orderly and continuous manner without undue delay, and in conformance with project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate plumbing work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of all piping, ductwork, light fixtures, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor’s responsibility to bring this to the attention of the Architect prior to initiation of work. Correct improperly coordinated installation at no additional cost.

E. The Contractors' assistants shall include a competent foreman, who shall be on the premises at all times to check, layout, coordinate and superintend the installation of work. The foreman shall establish all grades and lines relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers' and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for all equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of shop drawings and product data for every item of equipment. Shop drawings or product data will not be considered until manufacturers' lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor's name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.
3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.
4. Product data sheets shall be 8.5-inch by 11-inch cut sheets for operating and maintenance manual.

C. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of owner's representative, and project type and size.

D. After the work is completed, submit all required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the Architect prior to final acceptance of the work.

1.10 SPECIALIST

A. The term "Specialist" as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer's direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:

    a. Contract drawings.
    b. Specifications
    c. Addenda
    d. Change orders and other modifications to the Contract
    e. Reviewed shop drawings, product data, and samples

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:

    a. Manufacturer's name and product model and number
    b. Product options, substitutions, or alternates utilized
    c. Changes made by addenda and modifications

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:

a. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
b. Field changes of dimension and detail.
c. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.
2. Binders: Three-ring binders with vinyl-covered hard covers. Provide large enough binders, and sufficient quantity, that the required contents can be easily turned, removed, and reinserted.
3. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," and title of project. Print on spine of binder "O & M INSTRUCTIONS." If more than one binder is required, print covers and spines with volume numbers. Include in the front of every binder an index to all binders.
4. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
5. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.
6. Part 1: Directory, listing names, addresses, and telephone numbers of mechanical engineers; Contractor; mechanical subcontractors; and major mechanical equipment suppliers.
7. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

a. List of plumbing equipment, including operating weight of each.
b. Parts list for each plumbing fixture, faucet, and pump, including recommended spare parts list.
c. Operating instructions.
d. Maintenance instructions for plumbing equipment and systems.
e. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

8. Part 3: Project documents and certificates, including the following:

a. Shop drawings and product data for plumbing systems.
b. Photocopies of certificates.
c. Photocopies of warranties and guarantees.
d. Test reports: Copies of the results of all tests required under all sections of specifications.

9. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.
10. Submit final volumes revised, within ten days after final inspection.

1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The plumbing, mechanical, electrical, building, fire, and safety codes of the state and county or city in which the work is being performed.
2. The National Electric Code, NFPA 70 (NEC).
3. The National Fire Protection Association Code. (NFPA).
4. International Energy Conservation, Fire, Fuel Gas, Mechanical, and Plumbing Codes (ICC).

1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply. Products shall be certified by manufacturers to meet the requirements of referenced standards.

1. Federal Specifications (FS)
2. Military Specification (MS)

3. Military Standards (Mil. Std.)
4. Air Conditioning and Refrigeration Institute (ARI)
5. Air Movement and Control Association (AMCA)
6. Associated Air Balance Council (AABC)
7. American Association State Highway and Transportation Officials (AASHTO)
8. American National Standards Institute (ANSI)
9. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
10. ASME International (ASME)
11. American Society for Testing and Materials (ASTM)
12. American Society of Sanitary Engineering (ASSE)
13. American Water Works Association (AWWA)
14. International Code Council (ICC)
15. Manufacturer's Standardization Society of the Valve and Fittings Industry Inc. (MSS)
16. National Electrical Code, NFPA 70 (NEC)
17. National Electrical Manufacturer's Association (NEMA)
18. National Fire Protection Association (NFPA)
19. National Fuel Gas Code, NFPA 54
20. National Sanitary Foundation (NSF)
21. National Standard Plumbing Code (NSPC)
22. The Occupational Safety and Health Act (OSHA)
23. Piping and Drainage Institute (PDI)
24. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
25. Underwriters Laboratory Inc. (UL)
26. Maryland Occupational Safety and Health Act (MOSHA)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for all contents within these areas. Provide all security measures necessary for this area.

B. Area shall be maintained and shall be returned to original condition at the completion of the project.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.

3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair all damage or soiling to the complete satisfaction of the Architect; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, all at no addition to the Contract Sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer’s recommended temperatures.

E. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.16 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.17 SECURITY REQUIREMENTS

A. Coordinate with requirements of Division 01.

1.18 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in "Cutting and Patching" below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the Owner and Architect in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.19 WARRANTY

A. All work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties specified in individual sections.

B. During the correction period, the Contractor shall begin correcting any work found to be not in accordance with the requirements of the Contract Documents within 4-hours of receiving written notice from the Owner. Provide detailed schedule for completion of work within 24-hours of receiving written notice from the Owner and revise schedule based on any Owner comments generated. Except as otherwise required in General Conditions and Division 01, the correction period is one year after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

1. Service reports for warranty work shall be provided to the Owner.

C. When use of the permanent equipment has been permitted for temporary heating or ventilation of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers' standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of pipes, ducts and appurtenances. Close superfluous openings and remove all debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the Architect.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and all materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or Architect finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, Architect and Owner shall each be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

END OF SECTION 220101

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to more than one section of Division 22.

B. Basic material and equipment required for the plumbing piping work.

C. Cleaning and painting.

D. Piping tests.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 220101.

B. Operation and Maintenance Manuals: Division 01 and Section 220101.

C. Painting: Division 09.

1.3 REFERENCES

A. American Society of Mechanical Engineers

1. ASME A 13.1: Scheme for the Identification of Piping Systems
2. ASME B 31.9: Building Services Piping

B. American Society of Testing and Materials

1. ASTM B 32: Standard Specification for Solder Metal
2. ASTM B 88: Standard Specification for Seamless Copper Water Tube
3. ASTM B 813: Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
4. ASTM D 635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
5. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials
6. ASTM D 2564: Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems

7. ASTM F 656: Standard Specification for Primers for use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

C. American Welding Society

1. AWS D1.1: Structural Welding - Steel
2. AWS D10.9: Specification for Qualification of Welding Procedures and Welders for Piping and Tubing

D. NSF

1. NSF/ANSI 61: Drinking Water System Components - Health Affects
2. NSF/ANSI 372: Drinking Water System Components – Lead Content

1.4 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

C. DN: Dimension Nominale, nominal pipe size in millimeters, in accordance with the metric system for construction, Systeme Internationale (SI).

D. NPS: Nominal pipe size in inches, in accordance with standard U.S. designations for manufactured pipe. Pipe sizes do not change when projects are designed and built in metric units; each size has a consistent name (nominal dimension) in each system.

1.5 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed based on use of the particular manufacturer's products specified and scheduled on the drawings.

B. Products of other manufacturers that are listed under the article "Acceptable Manufacturers," or permitted as "equal," are permitted provided:

1. Product shall meet the specifications.
2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that render their use impractical, or cause functional fit, access, or connection problems.

1.6 SUBMITTALS

A. Certifications: Proof of operator and testing agency personnel qualifications as required for welding and brazing in the article "Quality Assurance" below.

B. Test reports: Field test results for each piping system as specified in Part 3 below.

1.7 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the plumbing, mechanical, electrical, building, fire, health and safety, and other applicable codes and regulations of the state, county or city in which the work is performed.

1. Product specifications herein may not necessarily meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

B. Brazing, and soldering procedures and operator qualifications for building systems piping:

1. ASME B31.9, Building Services Piping.
2. Copper Development Association "Copper Tube Handbook."
3. Safe Drinking Water Act.

C. UL label:

1. Electrical control panels, equipment, materials and devices provided or installed as work of Division 23 shall be UL listed and shall bear a UL label.
2. Equipment, including custom assemblies, shall be listed and labeled as an assembly.

3. If a UL label is not available, the item shall be tested and labeled by a qualified nationally recognized testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70 (NEC).
4. Provide testing, if required, without addition to the contract sum.

PART 2 - PRODUCTS

2.1 GENERAL

A. General piping techniques, testing, identification, painting, and operating instructions specified in this section apply to products specified in other sections of Division 22.

B. Equipment that uses or processes date and time data in order to perform its function shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

2.2 PIPING MATERIALS

A. Soldering materials:

1. Solder: Free of lead, antimony, and zinc and meeting the requirements of ASTM B 32. No solder containing lead is permitted.

a. Tin 95.5 percent, copper 4 percent, and silver 0.5 percent.

(1) Equal to “Silvabrite 100” manufactured by Engelhard Corporation.

b. Tin, copper, bismuth, and silver.

(1) Equal to “Oatey Silver” manufactured by Oatey.

2. Flux:

a. Meeting the requirements of ASTM B 813 and NSF 61 certified.
b. Equal to Oatey H-2095.

B. Threaded pipe joint materials:

1. Pipe jointing compound:

a. Pipe joint compound recommended by the manufacturer for use at the temperature and pressure of the system.
b. For sanitary piping overhead of food storage, preparation, and serving and dining areas: Litharge and glycerin.

2. Pipe joint tape: Polytetrafluoroethylene (PTFE) pipe thread tape, "Teflon."

3. Plastic PVC pipe joint materials:

a. Primer: ASTM F 656 and containing methyl ethyl ketone or acetone.

b. Solvent cement: ASTM D 2564.

2.3 MATERIALS FOR UNDERFLOOR INSTALLATION

A. Pipe: PEX tubing, ASTM F876, no joints under floor.

B. Conduit: Schedule 40 PVC pipe with long-radius elbows, size to accommodate copper tubing and insulation.

C. Insulation: Flexible elastomeric, as specified in Section 22 0719, Plumbing Piping Insulation.

D. Firestopping caulk:

1. Intumescent caulk, which, under heat, expands to five times its original volume, creating a char which can withstand flames and smoke for at least three hours.
2. Equal to 3M CP 25WB.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS AND EQUIPMENT

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify Architect if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

B. The contract drawings are diagrammatic and do not indicate all fittings or offsets in pipe, all access panels, or all specialties required. Provide required fittings, offsets, access panels, and specialties to coordinate the work.

C. No pipe shall be run below the head of a window or door.

D. Equipment and pipes installed in areas without a suspended ceiling shall be as tight to structure as possible, but at least above a height of 6'-8", unless otherwise noted.

E. Items which require access for operation or maintenance shall be easily accessible. Do not cut or form hand holes for operation or maintenance of appliances through walls or ceilings.

F. Provide installations compliant with NFPA 70.

3.2 PIPE INSTALLATION

A. Install pipe exposed to view parallel to building lines and as close to walls, columns, and ceilings as may be practical, maintaining proper clearances for access at all parts requiring servicing.

B. Install pipe a sufficient distance from other work to permit a clearance of not less than 0.5 inch (15 mm) between its finished covering and adjacent work.

C. Remove burrs resulting from cutting pipe or from any other operation.

D. Pitch water piping so that air in the system can be properly vented. Provide shutoff valves where necessary to isolate parts of system for repairs without draining the entire system.

E. Interface with other products:

1. Where pipe is provided through walls, provide finished, permanent, waterproof installation complete with inserts, sleeves, supports or hangers, seals, and other appurtenances as required. Do not pierce, cut, or notch any footing or other structural member.
2. Waterproofing and dampproofing of the building shall be unharmed by the installation of the work. Where pipe has to pierce waterproofing or dampproofing, including outside walls, the penetration shall be made watertight. Waterproofing damaged or destroyed shall be repaired or replaced with new waterproofing.

F. Thoroughly clean pipe and fittings before they are installed, and keep them clean until the acceptance of the completed work. Cap or plug the ends of the lines so as to prevent earth and other debris from entering during construction.

G. Threaded connections:

1. Cut threads full and clean.
2. Apply specified pipe joint compound or tape on male threads only.
3. Where piping is installed in crawl spaces and tunnels, cover exposed threads with rust-inhibitive paint. Apply after joints have been assembled and tested.

H. Copper tubing installation:

1. Cut pipe with a tubing cutter or fine-tooth saw. Cuts made with a saw shall be true and square, and the end shall be filed smooth with a fine-tooth file. Remove all marks and burrs with sandpaper.
2. Solder joints for copper tubing: Clean ends of tubing and inside of fitting ends thoroughly with emery cloth before applying flux.
3. Provide dielectric fittings between copper and steel piping to prevent electrolysis.
4. Follow the techniques for soldering and brazing pipe, fittings, and valves as recommended by the manufacturer.

3.3 CLEANING AND PAINTING

A. Cleaning: Clean all piping and equipment. Where items are to be painted, clean ready for painting.

B. Painting: Coordinate painting with requirements of Division 09. Paint the items identified below to be painted. Use paint materials and systems specified in Division 09.

C. Items to be painted:

1. Piping exposed in finished spaces, insulated and uninsulated.

D. Items not to be painted: Copper, stainless steel, and equipment furnished with manufacturer’s finish.

3.4 PIPING TESTS

A. Hydrostatic testing:

1. Notify Owner in writing at least 24 hours prior to the test.

2. Test before pipes are concealed or insulated.
3. Provide fluid, pumps, valves, and gages required for testing.
4. Where water is used as the test fluid, provide ambient temperature water and provide means to avoid freezing. Drain and dispose of test fluid when testing is concluded.
5. Isolate or remove any components with a pressure rating below the required test pressure.
6. Brace and support piping during the test, so that no movement, displacement, or damage results from the application of the test pressure.
7. Provide a pressure relief valve, set at a pressure no more than one-third higher than test pressure, to protect against damage caused by expanding liquid or other source of overpressure during test.
8. Replace piping or fittings found defective with new material.
9. Documentation of tests: Prepare a test report for each portion of piping tested, identified by service, material, location, and pipe size. Include these items:

    a. Date of test.
    b. Starting and completion times.
    c. Initial test pressure.
    d. Final test pressure.
    e. Problems or leaks detected.
    f. Corrective actions taken.
    g. Record of successful completion of testing.
    h. Name, title, and signature of person conducting test.

10. Piping Systems Test Schedule:

System	Test Pressure psig (kPa)	Duration	Allowable Drop	Medium
Domestic cold water piping	125 (860)	4 Hours	None	Water

END OF SECTION 220500

SECTION 220501 - EXCAVATION AND FILL FOR PLUMBING WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Trenching, backfilling, and compacting for plumbing work underground inside the building and extending five feet beyond exterior building walls, and outside the building as shown on drawings.

B. Restoring and reseeding grassed areas.

1.2 RELATED SECTIONS

A. Cutting and patching: Division 01 and Section 220101.

B. Piping:

1. Domestic water piping: Section 221116.
2. Sanitary waste and vent piping: Section 221316.
3. Storm drainage piping: Section 221413.

1.3 REFERENCES

A. ASTM D 1557: Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/cu ft

1.4 SUBMITTALS

A. Shop drawings: At the same scale as the contract drawings, showing field verified locations of utilities, and proposed detailed trenching plan.

B. Product data:

1. Warning tape
2. Seed and mulch

C. Certifications: Test reports showing that compaction meets specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill: Earth materials, free from perceptible amounts of wood, debris, or topsoil, free of frost at the time of placement, and not containing marl or other elements which tend to stay in a plastic state.

B. Underground warning tape: Polyethylene 0.004 inch (0.102 mm) thick for metallic lines, and for non-metallic lines polyethylene both sides with metallic lining, six inches (152 mm) wide.

   1. Colors: In accordance with APWA and AASHTO standards.
   2. Markings: Repeated continuously along the entire length, legend appropriate for line being identified.

C. Grass seed: Fresh new-crop seed, 90 percent pure and 85 percent germination. Mix: 70 percent Kentucky Bluegrass, 25 percent Red Fescue and 5 percent Red Top. Only strains of Kentucky Bluegrass found adaptable to Maryland shall be acceptable.

D. Mulch: Free of sticks, weeds, or other foreign matter; either licorice root, tan root, or tan bark; fibrous by-product of extraction. Use only one type throughout the project.

2.2 EQUIPMENT

A. Mechanical tampers for compacting backfill: Capable of exerting a blow equal to 250 pounds per square foot (12 kPa) of area of the tamping face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Contact local utility company underground information service (BGE Miss Utility) before beginning excavation outside buildings.

B. The general locations of underground utilities are indicated on the drawings and are not to be assumed to be accurate or complete. Before beginning work, field check the area with the most accurate instruments available, such as Fisher Labs' Pipe and Cable Locators.

3.2 INSTALLATION

A. Perform all excavating, cutting of paved areas, trenching, sheeting, shoring, backfilling, and compacting required for the proper installation of the work.

B. Where obstructions are encountered, obtain written approval and make necessary changes in line, grade or location.

C. Protect existing utilities from damage during excavation and backfilling. Repair damaged new or existing work at no addition to the contract sum. Bracing, shoring and other protection of existing utilities is part of this work.

D. Do not damage or remove existing shrubs or trees including their root systems, without prior notification to the Architect.

E. Provide temporary roadways over trenches with railings and other safeguards, including amber blinker lamps or other warnings for night use.

F. Note the depths of footings. In cases where piping is in close proximity to or below footings and where the natural earth under footings is disturbed, after the line is installed, the voids shall be filled up to bottoms of such footings with solid concrete.

3.3 CUTTING

A. Cut concrete and asphalt concrete with masonry saw prior to breaking it into smaller pieces for removal.

B. Cut sidewalks perpendicular to the length at the closest existing joint that is a minimum of 24 inches back from either side of the top of the new trench.

3.4 TRENCHING

A. Excavations inside the building shall be carefully planned. Stockpile excavated earth so as not to interfere with other construction. Dig trenches to the proper depths, providing extra depressions where required for hubs of pipes.

B. Excavations outside the building shall generally follow the routes indicated on the drawings. Stockpile topsoil separately for later replacement. Excavations shall be of sufficient depths to provide, unless indicated otherwise on the drawings, a minimum cover as follows:

1. Water piping: 42 inches (1067 mm).
2. Sewer lines: Elevations shown on drawings.

C. Trenches shall be of necessary depth and width for the proper laying of pipe with a minimum of 8 inches (205 mm) on each side of the joint.

1. The sides shall be as nearly vertical as practicable. Unless local regulations are more strict, trenches 4 ft. (1220 mm) and deeper shall have shored sides as required by OSHA trenching regulations.
2. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length, except for bell holes and for the proper sealing of the pipe joints.
3. No greater length of trench shall be left open, in advance of the completed structure placed in it, than can be completed in that day's operation.
4. Except where rock is encountered, do not excavate below the depths required. Where rock excavation is required, excavate to a depth of at least 6 inches (150 mm) below the trench depth and fill the overdepth with compacted crusher run or bank run stone or sand. Unauthorized overdepths in excavation shall be backfilled with crushed stone, slag or gravel, thoroughly compacted.
5. Whenever wet or otherwise unstable soil is encountered, it shall be removed to the depth and extent directed, and the trench backfilled to the proper grade with crushed stone, slag or gravel.

D. Should springs be encountered within the work area, or soft soil conditions at the elevations required for load bearing, immediately notify the Architect and do not place any portion of the work on such surfaces until instructions are received.

E. Furnish and maintain pumps, flumes, gutters, and appurtenances if required to keep the excavations free from water. Water shall be directed to a point remote from building operations, shown on the approved shop drawing.

F. Excavation for manholes and similar structures shall be sufficient to leave a minimum of 12 inches (305 mm) and a maximum of 24 inches (610 mm) clearance on all sides. Fill over-depth excavation with concrete.

3.5 BACKFILL

A. Place no backfill until the adjacent construction or the utility to be covered has been inspected, tested, and approved.

B. Installing underground warning tape: Install in backfill above exterior buried lines not encased in concrete. Select legend and color appropriate for type of line. Install metallic lined tape for non-metallic lines. Install approximately 12 inches (305 mm) below grade.

C. Plumbing systems backfill:

1. Backfill and compact in six-inch (150-mm) layers up to spring line of the pipe. The installations shall then be inspected and tested.

2. Following inspection, backfill in six-inch (150-mm) layers, each compacted, until the pipe has a cover of not less than one foot (305 mm). Place the remainder of the backfill material in the trench in eight-inch (200-mm) compacted layers.
3. Excavations improperly backfilled shall be reopened, then refilled and compacted to the required grade and compaction, and smoothed off.
4. Open trenches across roadways or other areas to be paved shall be backfilled as specified above, except that the entire depth of trench shall be backfilled in six-inch (150-mm) layers, and each layer shall be mechanically compacted.
5. Completed work shall have uniform graded surface, in accordance with the surface and grade indicated on the drawings.

D. Structure backfill:

1. Do not backfill against structures with cement mortar joints until the mortar is at least twelve hours old.

3.6 COMPACTION

A. Test in accordance with the requirements of ASTM D 1557.

B. Compact under slabs, roads, and sidewalks to a 95 percent density.

C. Compact unpaved areas to a 90 percent density.

D. Backfill and compact trench in unpaved areas to within 4 inches (102 mm) of existing grade. Furnish and install compacted select topsoil for the final layer to finish even with existing grade. Remove surplus earth and rake unpaved areas for final planting.

E. Take particular care in compaction of earth under joints of plumbing piping.

END OF SECTION 220501

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SECTION 220502 - SLEEVES AND PLATES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sleeves and escutcheon plates for piping systems.

B. Mechanical seals for piping penetrations.

1.2 SUBMITTALS

A. Product data: Sleeves, plates, sealants, and mechanical penetration seals.

PART 2 - PRODUCTS

2.1 SLEEVES, PLATES, AND ACCESSORIES

A. Steel sleeves: Schedule 40 black steel pipe, ASTM A 53.

B. Copper sleeves: Type L, ASTM B 88 hard drawn.

C. Cast-iron sleeves: Extra heavy, equal to product of U.S. Pipe Co. with waterstop and ends as shown on the drawings.

D. Plastic sleeves: Schedule 40 PVC, ASTM D 1785.

E. Sealing compound in walls and floors:

1. Bare and insulated pipes carrying fluids 150 degrees F (65 degrees C) and below:

   a. High-performance, moisture cured, 1-component, polyurethane-based, non-sag, elastomeric sealant. Use a primer for applications required by the manufacturer.
   b. Basis of design: Sika Corporation “Sikaflex – 1a.”

2. Bare and insulated piping carrying fluids 151 degrees F (66 degrees C) and above:

   a. One-part RTV silicone, neutral-cured, architectural grade sealant. Use a primer for applications required by the manufacturer.
   b. Basis of design: Dow Corning Corporation “795 Silicone.”

F. Floor, wall, and ceiling plates for existing piping: Stamped or cast brass with chrome finish and set screw, split and tabbed.

G. Floor, wall, and ceiling plates for new piping: Stamped or cast brass with chrome finish and set screw.

H. Mechanical penetration seals:

1. Seals shall be modular mechanical type, consisting of interlocking synthetic links shaped to continuously fill the annular space between the pipe and wall opening. Bolt and nut fasteners for the seals shall be stainless steel for units used in penetrations below grade.
2. Basis of design: PSI “Link-Seal Modular Seals” or Calpico Sealing Link “LINX”.

PART 3 - EXECUTION

3.1 INSTALLING SLEEVES

A. Install sleeves for piping, or piping with insulation continuous through sleeve, passing through walls, partitions, beams, or slabs.

1. Exception: Where steel pipe penetrates a steel beam that is not part of a fire- or smoke-rated assembly, no sleeve is required.

B. Do not cut, drill, or burn structural steel for installation of piping without specific instructions from the Architect.

C. Locations in nonfire-rated construction:

1. Install steel sleeves for penetrations of steel, iron, and insulated piping.
2. Install copper sleeves for penetrations of uninsulated copper tubing and piping.
3. Install plastic sleeves for penetrations of plastic piping. Plastic piping and sleeves are not permitted in ceiling spaces used as HVAC system plenums, or in shafts used for building HVAC air distribution.

D. Locations in floors and fire-rated construction: Sleeves used in piping penetrations through fire-rated construction shall be an acceptable component of the through-penetration firestop assembly as specified in 078400, Firestopping.

1. Where firestop assembly is UL listed, sleeve material shall be as directed in the listing.

2. Where other specified approval and acceptance is required, sleeve shall be as described in the approved assembly.

E. Install sleeves through walls and partitions flush with finished surfaces.

F. Sleeves through floors shall extend two inches (50mm) above top of finished floor and be finished neat and level. Provide projecting sleeves with anchor clips to prevent them from being loosened and knocked down in the floor construction.

G. Sleeves for insulated piping shall be sized to allow a one-inch gap between insulation and sleeve to accommodate insulation.

H. Seal spaces between sleeves and pipe, or pipe insulation, in nonrated walls, with mineral wool.

I. Penetrations in exterior masonry or concrete walls and foundations:

1. Sleeves: Cast iron, or in cast concrete may be core drilled.
2. Above grade: Mechanical penetration seal at outside face of wall.
3. Below grade: Mechanical penetration seal, at outside face of wall.

3.2 INSTALLING PLATES

A. Exposed piping passing through interior walls, partitions, floors, and ceilings shall be fitted with plates of size and depth to conceal sleeves. Secure plates firmly in place with set screws.

END OF SECTION 220502

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SECTION 220504 - PLUMBING DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Extent and location of demolition are shown on the drawings.

1.2 RELATED SECTIONS

A. Demolition: Section Division 02.

1.3 QUALITY ASSURANCE

A. Demolition shall be carried out as expeditiously as possible in accordance with accepted practice and applicable building code provisions.

1.4 PROJECT CONDITIONS

A. If, in the course of the work, workers encounter a material they suspect to be asbestos, to contain lead or PCBs, or to present some other hazard:

1. Promptly notify the Owner and Architect in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

B. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.

C. Locate, identify, and protect mechanical and electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Comply with demolition and disposal requirements of Division 02.

B. Perform removal work neatly with the least possible disturbance to the building.

C. Provide temporary barriers, danger signals, and appurtenances for protection of personnel and equipment during removal operations.

D. Demolish, remove, demount, and disconnect inactive and obsolete piping, fittings and specialties, equipment, ductwork, controls, fixtures, and insulation.

1. Remove materials above accessible ceilings.
2. Patch and repair surface materials as required in Section 017329, Cutting and Patching.

E. Remove anchors, bolts, and fasteners associated with piping and equipment to be removed.

3.2 DISPOSAL

A. Dispose of equipment and materials removed, and rubbish and waste material, as work progresses. Do not allow demolition debris to accumulate on site. Remove products of demolition from the building daily.

3.3 PROTECTION

A. Provide adequate and positive protection to existing building and equipment that is to remain, particularly to prevent entry of either dust or water. Ensure weathertightness at all times. Keep standby patching materials on hand to patch and maintain protection as required.

END OF SECTION 220504

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hose connections.

1.2 RELATED SECTIONS

A. Piping installation and testing: Section 220500.

B. Piping systems:

1. Domestic water piping: Section 221116.

1.3 REFERENCES

A. ASME B16.10: Face-to-Face and End-to-End Dimensions of Valves.

B. ASME B16.34: Valves - Flanged, Threaded, and Welding End.

1.4 SUBMITTALS

A. Product data: For each type of valve. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

1. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

B. Maintenance data: For inclusion in operation and maintenance manual specified in Division 01 and Section 220101. Include manufacturer's instructions for adjusting, servicing, disassembling, and repairing.

1.5 QUALITY ASSURANCE

A. Ferrous valves shall conform to ASME B16.10 and B16.34 for dimension and design criteria.

B. Copper alloy valves (brass and bronze) shall have no more than 15 percent zinc in the alloy.

C. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements. Product specifications herein may not define all product options necessary to meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Shutoff valves:

B. Hose connections: Subject to compliance with requirements, provide the specified Zurn valves, or comparable products by one of the following:

1. Jay R. Smith
2. Crane Co.
3. Josam Manufacturing Co.
4. Woodford Manufacturing Co.
5. Zurn

2.2 HOSE CONNECTIONS

A. Hose bibs:

1. Provide with factory installed ASSE 1011 hose connection vacuum breaker.
2. Bronze body, stem, and bonnet, chrome-finished where exposed and rough brass where concealed. Provide metal handle and operating key. Remove handle for key operation where hose bib is accessible to the public. Leave metal handle in place where concealed.
3. Pressure Rating: 125 psig (860 kPa).
4. Compression type valve with replaceable washer.
5. Handle operated.
6. NPS 0.5 (DN 13) inlet.
7. NPS 0.75 (DN 20) ASME B1.20.7 garden-hose thread outlet.
8. Basis of design: Zurn Z-1345.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install valves to be readily accessible for operation and maintenance, and with ample clearance for turning handles or operators.

B. For valves in inaccessible locations, provide access doors as specified in a related section.

C. Identify valves as specified in Section 220500, Common Work Results for Plumbing.

1. Provide tags for all valves except stop valves on individual fixtures or equipment where their function is obvious, or where the fixture or equipment is immediately adjacent. Numbers shall correspond to those shown on the Valve Chart. Attach tags to valve shaft.
2. Provide ceiling identification tags where valves are above an accessible suspended ceiling. Number shall correspond to tag number.

3.2 INSTALLING HOSE CONNECTIONS

A. Hose bibs: Provide hose bibs where indicated. In finished areas, locate units so that domestic water connection is concealed inside adjoining partition or furred space.

END OF SECTION 220523

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe hangers and supports.

B. Trapeze pipe hangers.

C. Metal framing systems.

D. Insulation protection.

E. Fasteners.

1.2 RELATED SECTIONS

A. Plumbing Piping Insulation: Section 220719.

1.3 REFERENCES

A. American Society of Mechanical Engineers

1. ASME B31.9: Building Services Piping.

B. ASTM International

1. ASTM A 36: Standard Specification for Carbon Structural Steel
2. ASTM A 53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A 307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
4. ASTM A 563: Standard Specification for Carbon and Alloy Steel Nuts
5. ASTM A 1064: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
6. ASTM C 533: Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
7. ASTM C 552: Standard Specification for Cellular Glass Thermal Insulation
8. ASTM F 594: Standard Specification for Stainless Steel Nuts

9. ASTM F 3125: Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated

C. American Welding Society

1. AWS-D.1.1: Structural Welding – Steel

D. Manufacturer's Standardization Society

1. MSS SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

1.4 DEFINITIONS

A. Hot Systems: Maximum operating (service) temperatures 120 degrees F (49 degrees C) and above.

B. Ambient Systems: Maximum operating temperatures 60 to 119 degrees F (16 to 48 degrees C).

C. Cold Systems: Maximum operating temperatures 59 degrees F (15 degrees C) and below.

1.5 SUBMITTALS

A. Product data:

1. Provide manufacturer's literature showing compliance with specifications for each type of hanger, framing system, support, fastener and accessory materials.
2. Provide a schedule of piping types and sizes and associated pipe hanger types.
3. Provide a schedule of building attachment types and associated attachment hardware.
4. Provide a schedule of pipe types and sizes and proposed hanger spacing and support rod diameters.
5. Provide manufacturer's recommended pipe hanger spacing criteria for stainless steel piping.
6. For supports used as components of fire protections systems, include certification of listing and label as required in "Quality Assurance" below.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Qualifications of welders: As specified in Section 220500, Common Work Results for Plumbing.

B. Hangers and supports used as components of fire protection systems shall:

1. Comply with NFPA 13.
2. Be listed and labeled by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Pipe hangers:

1. Anvil International
2. Carpenter and Paterson, Inc.
3. Cooper Industries
4. National Pipe Hanger Corporation
5. PHD Manufacturing, Inc.
6. PHP Systems/Design

B. Metal framing systems:

1. Anvil International
2. Cooper Industries
3. Hydra-Zorb
4. PHD Manufacturing, Inc.
5. PHP Systems/Design
6. Unistrut

C. Pipe covering protection shields:

1. Anvil International
2. Carpenter and Patterson, Inc.
3. Cooper Industries
4. National Pipe Hanger Corporation
5. PHD Manufacturing, Inc.
6. Pipe Shields, Inc.
7. Rilco Manufacturing Co., Inc.

2.2 PIPE HANGERS AND SUPPORTS

A. General: Comply with requirements of MSS SP-58.

B. Hangers and clamps:

1. Tunnels, and wet areas: Galvanized steel.
2. Typical interior applications: Galvanized steel or factory painted.
3. Exterior and corrosive applications: Stainless steel.
4. For use with uninsulated copper pipe: Copper plated.

C. Trapeze pipe hanger: MSS SP-58, Type 59, shop-fabricated or field-fabricated pipe support assembly made from structural carbon-steel shapes with pipe saddles and U-bolts to secure piping on top of hanger.

D. Supplemental materials:

1. Threaded rod: Continuously threaded.

    a. Zinc-plated or galvanized carbon steel for indoor applications.
    b. Stainless steel for outdoor and corrosive applications.

2. Nuts and washers: Provide the same material used for threaded rods (ASTM A 563 for steel, ASTM F 594 for stainless steel).
3. Structural carbon-steel shapes: ASTM A 36.
4. Steel pipe: ASTM A 53, Grade B, Type E (electric resistance welded), Schedule 40, black and galvanized steel.

E. Metal framing systems:

1. Description: Shop- or field-fabricated, pipe-support assembly made of channels, nuts, bolts, structural connections, accessories, fittings, and other manufactured components.
2. Standard: Comply with MFMA-4 for factory-fabricated components for field assembly.
3. Channels: Continuous slotted galvanized steel channel with inturned lips, width selected for applicable load criteria.
4. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Metal framing system pipe clamps:

a. Galvanized steel clamp pipe support with elastic stop nut, and hex head machine screw, and manufactured to connect to metal framing system channels.
b. For insulated piping: Clamp shall have friction tape on inside of clamp surface, manufactured to connect to pipe clamp insulating insert over pipe.
c. For uninsulated piping: Clamp shall have an integral molded thermoplastic elastomer clamping insert on inside of clamp surface, manufactured to connect to uninsulated pipe.

F. Insulation protection:

1. Pipe covering protection shield:

a. Shield: Galvanized steel, meeting the requirements of MSS SP-58 Type 40. Provide with alignment ridges when used in conjunction with pipe hanger.
b. Structural insulation insert: Structural insulation insert to form the insulation for the lower half of, or the entire pipe circumference Provide ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength; or ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength. Insert thickness shall match adjacent piping insulation thickness.

2. Combination insulating insert and insulation protection shield:

a. Insulating insert material for cold and ambient system piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength and vapor barrier. Insert thickness shall match adjacent piping insulation thickness.
b. Insulating insert material for hot system piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength; or ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength. Insert thickness shall match adjacent piping insulation thickness.
c. Insulation protection shield: Galvanized steel.
d. Insulating insert and insulation protection shield shall cover entire circumference of pipe.
e. Insulating insert length: Extend 2 inches minimum (50 mm) beyond insulation protection shield.

3. Pipe covering protection saddle:

a. Saddle: Steel, meeting requirements of MSS SP-58 Type 39

b. Insulation insert: Insulating material located in the space between saddle and pipe.

4. Pipe clamp insulating insert:

a. Insulating insert material: Closed-cell, sponge or expanded rubber, ASTM C 534, Type I for tubing material, with integral supports constructed from non-compressive closed cell material, single piece construction with self-adhesive closure strips. Insert thickness shall match adjacent piping insulation thickness. If insulation thickness is not available, provide maximum available thickness and seal insulation vapor barrier at thickness transition.
b. Insulation protection jacket: Aluminum or stainless steel, bonded to insulation insert.
c. Insulating insert and jacket shall cover entire circumference of pipe.
d. Basis of design: Armacell "Armafix" insulating inserts.

2.3 FASTENERS

A. Mechanical expansion anchors:

1. Self-drilling type expansion shields or machine bolt drop-in anchors for drilled holes. Fasteners to floor slabs shall be vibration and shock resistant. Load applied to fasteners shall not exceed 25 percent of manufacturer's stated load capacity in 3500 psi (24,000 kPa) concrete. Provide zinc-coated anchors for indoor applications and stainless-steel anchors for outdoor applications.
2. Basis of design: ITT Phillips Anchors "Red Head."

B. Fasteners to drywall or cavity wall construction:

1. Toggle bolts with hollow wall drive anchors or nylon anchors as required.
2. Basis of design: ITT Phillips Anchors "Red Head" toggle bolts.

C. Fasteners to wood construction: Lag bolts.

D. Bolts, nuts, and washers: ASTM A 307, or ASTM F 3125 where high strength is required.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide hangers and supports in accordance with schedules at the end of this section, as modified by specifications for each location and type.

B. Comply with MSS SP-58. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

C. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Where required, provide structural steel shapes or metal framing system channels and hardware to transfer load from a hanger location to multiple locations in the structure in order to get support from an appropriate location or to increase the strength of the connection to the structure.

E. Support horizontal piping from above with hangers and threaded rod where possible, unless otherwise indicated.

F. Secure vertical piping at stack bases.

G. Support vertical piping at each floor with riser clamps. Provide additional supports as needed not to exceed scheduled maximum vertical support spacing.

H. Provide hanger sizes to allow for continuous insulation for insulated piping systems.

I. Fabricate wall-mounted and floor-mounted supports using metal framing systems or structural steel where required.

J. Support groups of small piping along a structural wall using a metal framing system secured to the wall.

K. Trim threaded rods with a maximum excess length of 1 inch (25 mm). Provide protective rubber red end caps on the ends of threaded rods exposed and within 8 feet (2.4 meters) of the floor, roof, or grade below.

L. 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.

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

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

O. 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. Coordinate with requirements for hangers that require vibration control. See Section 23 0548.

Q. Trapeze pipe hangers: Provide where required for grouping of parallel runs of horizontal piping.

1. Weld steel according to AWS D-1.1.
2. Hang with threaded rods. Size threaded rods in accordance with MSS SP-58.
3. Design trapeze pipe hangers and supports based on supported load plus a 50 percent minimum safety factor.
4. Hanger spacing shall not exceed the requirements for the smallest pipe in the rack.
5. Hanger spacing shall not exceed 6 feet (1.8 m) where hung from wood.

R. Metal framing systems: Provide where required for grouping of parallel runs of piping, and support together on field-assembled strut systems. Comply with MFMA-103 for metal framing system selections and applications.

S. Remove, add, and modify existing hangers and supports to coordinate with new work and support existing to remain elements.

3.2 BUILDING ATTACHMENTS

A. Attaching to structural walls:

1. Provide a minimum of two 0.375 inch (9.5 mm) minimum screw-type fasteners for attaching brackets and a minimum of three 0.5 inch (13 mm) minimum bolt-type fasteners for attaching structural supports.

B. Attaching to structural steel beams, channels, or angles:

1. Secure threaded rods to MSS SP-58 Type 20 adjustable beam clamps that are clamped to the bottom flange of steel beams for any pipe size.
2. Secure threaded rods to MSS SP-58 Type 23 beam clamps for beams with maximum flange thickness of 0.75 inch (19 mm) and for single pipes NPS 2 (DN 50) and smaller.

C. Attaching to bar joists:

1. Provide MSS SP-58 Type 19 top-beam C-clamps attached to top flange of the joists at panel points.
2. Piping perpendicular to joists:

    a. Pipes NPS 2.5 (DN 65) and smaller: Support from at least every other joist to spread the load among joists. Where multiple pipes are grouped together, stagger hangers to distribute the load among available joists.
    b. If additional support is required between joists, hang metal framing system channel or structural steel shape from joists using MSS SP-58 Type 19 C-clamps attached to the top flange of two joists, and hang piping from metal framing system channel or structural steel shape.

3. Piping parallel to joists:

    a. Hang metal framing system channel or structural steel shape from joists using MSS SP-58 Type 19 C-clamps attached to the top flange of two joists. Hang piping from metal framing system channel or structural steel shape.
    b. For pipes NPS 2.5 (DN 65) and smaller: A single pipe may be hung from a single joist.

4. Existing floor construction:

    a. Provide toggle bolts, or remove and repair topping slab and support pipe as indicated above.

5. Roof construction:

    a. Provide toggle bolts.

6. Where several pipes are run in parallel, stagger individual hangers to avoid concentrating the load on a single plank.
7. Provide supplemental steel with connections to multiple planks where required to spread a load among multiple planks.

D. Attaching to steel decks: Not permitted.

E. Attaching to metal grating:

1. Piping perpendicular to structural members supporting grating:

    a. Attach threaded rods to the structural members using MSS SP-58 Type 23 beam clamps.

b. If intermediate support is needed for proper hanger spacing, attach additional threaded rods to 2.5 by 2.5 by 0.25-inch (90 by 90 by 8-mm) angles, 12 inches (305 mm) long, welded to the underside of the grating.

2. Piping NPS 2 (DN 50) and smaller parallel with structural members supporting grating:

   a. Attach threaded rods to 2.5 by 2.5 by 0.25-inch (90 by 90 by 8-mm) angles, 12 inches (305 mm) long, welded to the underside of the grating for piping between structural members.
   b. Attach threaded rods to the structural members using MSS SP-58 Type 23 beam clamps for piping under structural members.

3. Piping NPS 2.5 (DN 65) and larger parallel with structural members supporting grating:

   a. Support as specified above for bar joist construction.
   b. Hang metal framing system channel or structural steel shape from structural members using MSS SP-58 Type 23 beam clamps. Hang piping from metal framing system channel or structural steel shape.

4. Threaded rods shall have locknuts.

3.3 INSTALLING CAST-IRON PIPING

A. Support piping within 18 inches (460 mm) of each horizontal joint in addition to satisfaction of maximum hanger spacing. Where there are multiple joints in a 4 foot (1.2 m) section, supports may be provided at every other joint.

B. Support piping at changes in direction.

C. Where pipe is supported by hangers more than 18 inches (460 mm) long, provide lateral support at a maximum interval of 40 feet (12.2 m) with sway bracing.

D. Secure closet bends, traps, and similar items against movement in any direction.

3.4 PIPING HANGER AND SUPPORT SCHEDULES

A. Insulated cold and ambient applications: Applications include, but are not limited to, domestic cold water and insulated sanitary and storm water systems.

HANGERS & SUPPORTS FOR INSULATED COLD AND AMBIENT APPLICATIONS		
MSS SP-58 Classification	Description	Piping Applications
Hung from Above		
Types 1 & 40	Clevis hanger & pipe covering protection shield.	NPS 0.5 (DN 15) through NPS 2 (DN 50)
Type 59 (with combination insulating insert and insulation protection shield)	Trapeze pipe hanger with pipe saddles & U-bolts (with combination insulating insert and insulation protection shield).	NPS 0.5 (DN 15) through NPS 4 (DN 100)
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	NPS 0.5 (DN 15) through NPS 4 (DN 100)
Supported from Below		
Type 37 (with combination insulating insert and insulation protection shield)	Adjustable pipe stanchion saddle with U-bolt and floor flange anchored to floor (with combination insulating insert and insulation protection shield).	All sizes where supported from floor or a concrete support pier.
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	NPS 0.5 (DN 15) through NPS 8 (DN 200)
Risers		
Type 8	Riser clamp.	All sizes

B. Uninsulated applications: Applications include, but are not limited to uninsulated storm water, sanitary, vent.

HANGERS & SUPPORTS FOR UNINSULATED APPLICATIONS		
MSS SP-58 Classification	Description	Piping Applications
Risers		
Type 8	Riser clamp.	All sizes

C. Minimum threaded rod sizes: Provide at least the following minimum rod diameters for single rods supporting a single pipe hanger.

Pipe Size	Minimum Rod Diameter
NPS 2 (DN 50) and below	0.375 inches (10 mm)

D. Maximum hanger and support spacing for pressurized piping: Provide additional hangers or supports for concentrated loads such as flanges, valves, expansion compensators, fittings, and other specialties.

1. Horizontal spacing:

Pipe Size	Copper Piping	Ductile Iron Piping
NPS 0.75 (DN 20) and below	5 feet (1.5 m)	7 feet (2.1 m)
NPS 1 (DN 25)	6 feet (1.8 m)	
NPS 1.25 (DN 32)	7 feet (2.1 m)	
NPS 1.5 (DN 40)	8 feet (2.4 m)	9 feet (2.7 m)
NPS 2 (DN 50)		10 feet (3 m)

2. Vertical spacing:

Copper Piping	Ductile Iron Piping
10 feet (3 m)	15 feet (4.5 m)

END OF SECTION 220529

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Definitions and general requirements applicable to the insulation systems specified in "Related Sections."

1.2 RELATED SECTIONS

A. Plumbing piping insulation: Section 220719.

1.3 REFERENCES

A. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials

B. NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Materials

C. UL 723: Standard for Test for Surface Burning Characteristics of Building Materials

1.4 DEFINITIONS

A. Concealed insulation shall include work:

1. Above ceilings.
2. Where furred in and in pipe chases.

B. Exposed insulation shall include work:

1. In all rooms and areas.
2. In mechanical equipment rooms, penthouses, or other similar utility spaces.
3. In storage rooms.

C. Unconditioned areas: Areas outside of the insulated envelope.

D. Finished spaces: Areas of the building accessible to the public and to building occupants other than service personnel.

1.5 QUALITY ASSURANCE

A. Perform work in strict accordance with the building, fire and safety codes of the state, county or city in which the work is performed.

B. Insulation, including fittings and butt strips, jackets, facings, and accessories such as adhesives, mastics, cements, tapes and cloth, shall have a fire and smoke hazard rating and label as tested by ASTM E84, NFPA 255, and UL 723, not exceeding Flame Spread 25, Fuel Contributed 50, Smoke Developed 50.

C. All insulation and accessories shall be free of asbestos.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation and accessory products in manufacturers' wrapping or cartons, identified on the exterior and bearing labels showing conformance to flame and smoke rating requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to sections listed in “Related Sections.”

PART 3 - EXECUTION

Not Used.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Domestic cold water piping.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Water meter for monitoring by HVAC control system: Section 230913.

1.3 RELATED SECTIONS

A. Piping installation and testing: Section 220500.

1.4 REFERENCES

A. American Society of Mechanical Engineers

1. ASME B 16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
2. ASME B16.24: Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500

1.5 DEFINITIONS

A. Domestic water system: Potable water system for general human use, including hot and cold water supply and return.

1.6 SUBMITTALS

A. Product data: Each type of pipe and fitting included in the project.

1. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

B. Certifications: Disinfection test report

C. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

1.7 QUALITY ASSURANCE

A. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61, NSF/ANSI 372 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.

B. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements.

C. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label directly on the pipe, indicating compliance.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SUPPLIERS

A. Disinfection of domestic water system:

1. ARC Water Treatment Company, Inc.
2. Ecolab
3. Water Chemical Services, Inc.
4. Olin Water Services

2.2 ABOVE GROUND PIPE

A. Copper: ASTM B 88, Type L hard drawn.

2.3 ABOVE GROUND FITTINGS

A. General requirements for fittings:

1. Elbows in piping NPS 4 (DN 100) and larger shall be long radius type.

B. Cast or wrought fittings for copper pipe:

1. General: Solder joint, cast brass, ASME B16.18; or wrought copper, ASME B16.22.
2. Flanges: Bronze, solder type, ASME B16.24, Class 150.

PART 3 - EXECUTION

3.1 GENERAL

A. Install domestic water piping as shown on the drawings and in accordance with the provisions of Section 220500, Common Work Results for Plumbing.

B. Install piping in accordance with the Schedule of Pipe Systems, Sizes, and Materials at the end of this section.

C. Provide drain valves at low points of domestic water system for drainage.

3.2 TESTING OF DOMESTIC WATER SYSTEM

A. When domestic water piping is completed, and before strainer baskets are installed, pressure test at the pressure shown in Piping Test Table in Section 220500.

3.3 CLEANING OF DOMESTIC WATER SYSTEM

A. Flushing of new piping segments:

1. Flush new domestic cold water, domestic hot water, recirculated hot water, and tempered water piping before using. Unless prescribed otherwise by the county or state health department, the method of flushing shall be as follows:
2. Do not allow flushing water for piping to travel through plumbing equipment. Isolate equipment by closing isolation valves and opening bypass valves or by leaving piping disconnected from equipment.
3. Flush new piping after new piping has been completed and prior to connection to existing building systems.
4. Flush new piping segments as the work progresses.
5. Provide temporary domestic water and drain piping as needed. Remove when flushing is complete.
6. Drain water from the segment low point to a safe location and replace water at the same rate.
7. Continue until drain water is free from sediment, scale, rust and other foreign substances.
8. Flush every new branch of piping, for a minimum of 15 minutes after running clean.

3.4 SCHEDULE OF PIPE SYSTEMS, SIZES AND MATERIALS

A. Pipe schedules apply to domestic cold water, domestic hot water, domestic hot water return, and domestic temper water piping.

B. Above ground piping:

	Copper Type L cast or wrought fittings
NPS 2.5 (DN 65) and smaller	X

END OF SECTION 221116

SECTION 22 1113 – FACILITY WATER DISTRIBUTION 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. Pipe and fittings.
2. Nonpressure and pressure couplings.
3. Expansion joints and deflection fittings.
4. Backwater valves.
5. Cleanouts.
6. Encasement for piping.
7. Manholes.

1.3 APPLICABLE SPECIFICATIONS

A. American Association of State Highway and Transportation Official (AASHTO).

B. American National Standards Institute (ANSI).

C. DC Water

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

E. American Water Works Association (AWWA).

F. Corps of Engineers CRD-588.ACTION.

1.4 APPLICABLE REFERENCE

A. Erosion and Sediment Control Field Handbook

B. DC Water

1.5 ACTION SUBMITTALS

A. Submit full descriptions and details of all pipe, precast manholes, frames and covers, and other appurtenances proposed for the project. Submit certifications from the manufacturers that the inspections and tests specified in the referenced standards have been made and that the results of such inspections and tests comply with the requirements of the applicable standard.

B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.6 QUALITY ASSURANCE

A. Inspection and Testing of Pipe

1. The Engineer will inspect pipe, fittings and joint material upon delivery to the site. The Contractor shall provide ample space between rows of stockpiled pipe to facilitate the inspection.
2. The manufacturer shall provide facilities or a certified laboratory for conducting load bearing, hydrostatic and other tests required for production by the ASTM.
3. Air tests and infiltration tests of the completed installation shall be conducted by the Contractor in the presence of the Engineer.
4. Final inspection will be conducted by the Engineer after completion of final paving and finished grading.

B. Sanitary Sewer Field Tests

General: Acceptance tests (air tests) shall be specified for all new sanitary sewer main construction. Acceptance tests shall not be made until all sanitary sewer pipes, manholes and required building spurs have been installed, and the pipe trenches are backfilled to the finished grade and compacted. Prior to backfilling sanitary sewer sections, the Contractor may perform preliminary tests at his own discretion without the presence of the Engineer. The Contractor shall schedule the final acceptance tests with the Engineer at least 48 hours in advance. Final acceptance tests shall be performed in the presence of the Engineer or his duly authorized representative. All material, equipment and labor required shall be provided by the Contractor. Sewer pipes shall be tested from manhole to manhole or from manhole to terminus. Sections passing the acceptance tests shall continue to be maintained by the Contractor until a satisfactory final inspection of the entire sewer system is completed.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, 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.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

A. Pipe: ASTM A 746, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, ductile iron, for push-on joints.

D. Gaskets: AWWA C111, rubber.

E. Lining: Shall be corrosion resistant to sewer gas, sewpercoat, Protecto 401 or approved equal.

2.2 DUCTILE-IRON, PRESSURE PIPE AND FITTINGS

A. Push-on-Joint Piping:

1. Pipe: AWWA C151. (ANSI A21.51), minimum class 52.
2. Standard Fittings: AWWA C110, ductile or gray iron.
3. Compact Fittings: AWWA C153.
4. Gaskets: AWWA C111, rubber, of shape matching pipe and fittings.

5. Lining: Shall be corrosion resistant to sewer gas, sewpercoat, Protecto 401 or approved equal.

B. Mechanical-Joint Piping:

1. Pipe: AWWA C151, with bolt holes in bell.
2. Standard Fittings: AWWA C110, ductile or gray iron, with bolt holes in bell.
3. Compact Fittings: AWWA C153, with bolt holes in bells.
4. Glands: Cast or ductile iron; with bolt holes and high-strength, cast-iron or high-strength, low-alloy steel bolts and nuts.
5. Gaskets: AWWA C111, rubber, of shape matching pipe, fittings, and glands.

2.3 CONCRETE PIPE AND FITTINGS

Concrete pipe smaller than 12-inch shall not be used as sanitary sewer pipe. Concrete sewer pipe 12-inch and larger may be used only with special approval and shall be reinforced concrete pipe (RCP), of minimum Class IV, conforming to ASTM C-76. The pipe shall have bell and spigot ends with rubber gasket joints conforming to ASTM C-443.PVC PIPE AND FITTINGS

2.4 POLYVINYL CHLORIDE PIPE (PVC)

A. PVC pipe and fittings, 4-inch through 15-inch maximum diameter, shall meet requirements of ASTM D3034, wall thickness classification SDR-35 and shall be colored green for in-ground 02510-3 identification as sewer pipe.

PVC pipe shall be furnished in lengths of not less than 12 feet. PVC pipe and fittings shall be legibly marked in accordance with ASTM D3034, and in addition shall have the following markings; manufacturer's lot number, date of manufacture and point of origin. Pipe not marked as indicated will be rejected. Date of manufacture shall not be more than six (6) months prior to date of installation. Pipe and fittings shall have integral bell gasket joint. Joints shall meet the requirements of ASTM D-3212, and gasket shall meet requirements of ASTM F477.

2.5 FIBERGLASS PIPE AND FITTINGS

A. Fiberglass Nonpressure Fittings: ASTM D 3840, RTRF, for gasketed joints.

1. Reinforcement: Grade with finish compatible with resin.

2.6 EXPANSION JOINTS AND DEFLECTION FITTINGS

A. Ductile-Iron, Flexible Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. EBAA Iron, Inc.
    b. Romac Industries, Inc.
    c. Star Pipe Products.

3. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated.

B. Ductile-Iron Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Dresser, Inc.
    b. EBAA Iron, Inc.
    c. JCM Industries, Inc.
    d. Smith-Blair, Inc.; a Sensus company.

3. Description: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for expansion indicated.

C. Ductile-Iron Deflection Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. EBAA Iron, Inc.

3. Description: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for up to 15 degrees of deflection.

2.7 BACKWATER VALVES

A. Cast-Iron Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Josam Company.
   b. Smith, Jay R. Mfg. Co.
   c. Tyler Pipe.
   d. Watts Water Technologies, Inc.
   e. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. PVC Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Canplas LLC.
   b. IPS Corporation.
   c. NDS.
   d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.

3. Description: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

2.8 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Josam Company.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.
    d. Tyler Pipe.
    e. Watts Water Technologies, Inc.
    f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

3. Description: 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.
4. Top-Loading Classification(s): Light Duty, Medium Duty, Heavy Duty and Extra-Heavy Duty.
5. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Canplas LLC.
    b. IPS Corporation.
    c. NDS.
    d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
    e. Sioux Chief Manufacturing Company, Inc.
    f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.

3. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.9 MORTAR

A. Mortar used in the repair of existing concrete block structures shall be one part Portland cement conforming to ASTM C-150, Type II, and two parts sand conforming to ASTM

C144, with enough water added to produce mortar of the proper consistency for the type of joint.

2.10 MANHOLE PIPE SLEEVES OR BOTH

A. All sanitary sewer main connections to existing manholes shall be made by coring the manhole wall above the existing bench. Sewer pipe shall be connected to manhole by approved flexible boot.

B. Flexible connection of sewer pipe to manhole shall provide a positive, watertight compression joint allowing for 10o omni-directional deflection. Manhole boots or sleeves shall be manufactured of 3/8-inch flexible neoprene rubber conforming to ASTM C-443 specifications or 3/16-inch flexible ethylene propylene rubber conforming to ASTM C-923. Sleeves shall utilize a stainless steel clamp to secure pipe and shall be the flexible rubber foot of the “Kor 'N' Seal” system as manufactured by an approved manufacturer.

2.11 MANHOLES

A. Standard Precast Concrete Manholes:

1. Precast concrete manhole bases, risers and cones shall conform to the requirements of ASTM C-478 with configurations as shown in the drawings. Cones shall be eccentric. Manhole sections for sanitary sewer shall be of male and female end with a preformed groove provided in the male end for placement of a round rubber gasket ring. Rubber gasket rings shall meet the requirements of ASTM C-361 or C-443. The gasket shall be the sole element utilized in sealing the joint from either external or internal hydrostatic pressure. Contractor shall use the appropriate lubricant as directed by the manufacturer.

2. Each precast section shall be clearly marked on the inside near the top with the following information where applicable: ASTM designation, Standard detail or drawing number, station location and designation, date of manufacture and name or trademark of manufacturer. Precast concrete manholes shall be manufactured by Americast, or approved equal.

B. Manhole Frames and Covers

1. Manhole frames and covers shall be constructed of gray or ductile iron conforming to ASTMA-48 and A-536. Frames and covers shall have machined bearing surfaces to prevent rocking and rattling under traffic. Manhole covers shall be as shown on

the standard details and as indicated on the approved plans. Frames and covers shall be manufactured by Capitol Foundry, or approved equal.

2. Flexible plastic gaskets between bolted manhole cover and manhole frame seat shall be extruded rope Type B, conforming to AASHTO M-198, butyl based, ¾ inch diameter minimum.

C. Manhole Steps

1. Manhole steps shall be a composite of No. 3 grade 60 deformed steel bar incased in copolymer polypropylene plastic of the "press-fit" design or rubber. Steps shall be PSI-PF as manufactured by M.A. Industries, Inc. or Wedge-Lok as manufactured by Delta Pipe Products Inc., or approved equal.

2.12 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

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: 1 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

2.13 SANITARY GRADE LINER

A. General: Add thermos lining to all sanitary pipes.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. 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 using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 0.5 percent unless otherwise indicated.

2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
3. Install piping with 48-inch cover or 60 inches where subject to vehicular loading.
4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
6. Install ductile-iron, gravity sewer piping according to ASTM A 746.
7. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
8. Install PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 1668.
9. Install PVC corrugated sewer piping according to ASTM D 2321 and ASTM F 1668.
10. Install PVC profile sewer piping according to ASTM D 2321 and ASTM F 1668.
11. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
12. Install PVC gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
13. Install fiberglass sewer piping according to ASTM D 3839 and ASTM F 1668.
14. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
15. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

G. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:

1. Hub-and-spigot, cast-iron soil pipe.
2. Hubless cast-iron soil pipe and fittings.
3. Ductile-iron pipe and fittings.
4. Expansion joints and deflection fittings.

H. 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.

I. Pipes are to be stenciled at least once every four feet with permanent waterproof paint or approved equal. Stencil shall be minimum 1” letters SAN for sanitary sewer.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:

1. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
2. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
3. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
4. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.

B. Join force-main, pressure piping according to the following:

1. Join ductile-iron pressure piping according to AWWA C600 or AWWA M41 for push-on joints.
2. Join ductile-iron special fittings according to AWWA C600 or AWWA M41 for push-on joints.
3. Join PVC pressure piping according to AWWA M23 for gasketed joints.
4. Join PVC water-service piping according to ASTM D 2855.
5. Join dissimilar pipe materials with pressure-type couplings.

C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

    a. Unshielded flexible couplings for pipes of same or slightly different OD.
    b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure pipe couplings for force-main joints.

3.4 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Install FRP manholes according to manufacturer's written instructions.

D. Form continuous concrete channels and benches between inlets and outlet.

E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

F. Install manhole-cover inserts in frame and immediately below cover.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.6 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping manholes or pits.

B. Install combination horizontal and manual gate valves in piping and in manholes.

C. Install terminal-type backwater valves on end of piping and in manholes. Secure units to sidewalls.

3.7 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service.
4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.8 CONNECTIONS

A. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi .
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. 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.

3.9 CLOSING ABANDONED SANITARY SEWER 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.

B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:

1. Remove manhole and close open ends of remaining piping.
2. Remove top of manhole down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Section 312000 "Earth Moving."

3.10 IDENTIFICATION

A. Comply with requirements in Section 31200 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.11 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.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

    a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
    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.

6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

    a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
    b. Option: Test concrete gravity sewer piping according to ASTM C 924.

7. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig.

    a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
    b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

8. Manholes: Perform hydraulic test according to ASTM C 969.

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.

3.12 CLEANING

A. Clean dirt and superfluous material from interior of piping and flush with potable water.

3.13 AS-BUILT DRAWINGS

A. Provide reproducible as-built drawings, and in electronic format, prepared by a certified land surveyor practicing in the Commonwealth of Virginia for all new sanitary sewer work appurtenances. Obtain necessary County approvals of as-builts from DDES and ISD. Reproducible as-built drawings, incorporating any DES or ISD approval comments shall also be provided on Mylar for retention by the Owner.

END OF SECTION

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sanitary piping

B. Equipment drains

1.2 RELATED SECTIONS

A. Piping installation and testing: Section 220500.

B. Sanitary waste piping specialties: Section 221319.

1.3 REFERENCES

A. Cast iron piping standards

1. ASTM A 74: Standard Specification for Cast Iron Soil Pipe and Fittings
2. ASTM C 564: Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
3. ASTM C1540: Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings
4. CISPI 301: Standard Specification for hubless cast iron soil pipe and fittings for sanitary and storm drain, waste, and vent piping applications

1.4 SUBMITTALS

A. Product data: Each specified material and product.

B. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

1.5 QUALITY ASSURANCE

A. Cast iron pipe and fittings shall be marked with the collective trademarks of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.

B. Prior to any new piping installation, the Contractor shall verify the inverts of all piping to which new work is to be attached. The Contractor shall demonstrate to the satisfaction of the construction manager and/or Owner, that the connections to existing sanitary pipes meet the intent of the contract.

C. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label, directly on the pipe, indicating compliance.

D. The Contractor shall rod, clean, and flush existing sanitary piping as necessary to maintain gravity flow.

E. Prior to beginning the addition construction or work in any phase, the Contractor shall inspect via video camera and digitally record, for turnover to the Owner, all existing underground sanitary pipes sized 2 inches in diameter or above. The Contractor shall notify the Construction Manager and Owner immediately of any clogged, broken, or collapsed piping which is to remain or any conditions preventing free gravity flow.

F. Upon completion of the addition or each phase, the Contractor shall re-inspect via video camera and digitally record, for turnover to the Owner, all existing underground sanitary pipes sized 2 inches in diameter or above.

G. After all new construction is complete, all underground pipes sized 2 inches in diameter and above shall be inspected via video camera and digitally recorded for turnover to Owner.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Install each type of pipe and fittings in locations required or permitted in Part 3, including the Pipe Installation Schedule at the end of the section.

B. Cast-iron hub and spigot pipe and fittings:

1. Pipe: ASTM A 74 service class
2. Neoprene gaskets joints:

    a. Lifetime ASTM C 564 neoprene gasket joints
    b. Basis of design: Fernco “Multi-Tite”, Tyler Pipe “Ty-seal”, or Mission Rubber “Mission-Tite.”

C. Cast-iron no-hub pipe and fittings:

1. Pipe and fittings: Cast Iron Soil Pipe Institute Standard 301.
2. Joints: Use one of the no-hub coupling options below

a. Option 1 (for use in any location):

(1) ASTM C 564 neoprene gaskets and two-piece cast-iron housing clamps and stainless-steel bolts and nuts.
(2) Basis of design: Products of MG Piping Products Company.

b. Option 2 (for use in any location):

(1) Corrugated 304 stainless-steel shields with four or six clamps and holding bolts conforming to ASTM C 1540 and rubber gasket sealing sleeves conforming to ASTM C 564
(2) Basis of design: Husky “Series 4000” coupling or Mission "Heavy Weight Series CHW" coupling.

c. Option 3 (for use only where readily accessible, concealed from view, and in buildings that are 40 feet (12 meters) or less in height. These fittings may not be used above kitchens, dining rooms, food storage, or other food service areas.):

(1) ASTM C 564 neoprene gaskets and 24-gauge Type 304 stainless-steel housing, two stainless-steel bolted clamps.

3. Pipe and fitting restraints:

a. Provide for piping NPS 5 (DN 125) and larger
b. Factory fabricated pipe and fitting restraint assemblies rated to prevent pipe separation under fluid thrust forces up to 50 feet of head in conformance with CISPI 301.
c. Basis of design: Holdrite No. 117 No-Hub Pipe and Fitting Restraint.

PART 3 - EXECUTION

3.1 PREPARATION

A. Connect piping as shown on the drawings. Check elevations of connection points before installing new work.

3.2 INSTALLATION, GENERAL

A. Use suitable tools and appliances for the safe and convenient handling and laying of pipe. Examine each section of pipe for defects. Do not lay any piece that is known to be defective. If any defective piece should be discovered after having been laid, remove and replace it at no change to the contract price.

B. Install piping in accordance with the Pipe Installation Schedule at the end of this section, as indicated on the drawings, and in accordance with Section 220500, Common Work Results for Plumbing. Materials and work shall conform to local plumbing codes and health department regulations.

C. Thoroughly clean all pipe and fittings before installing them, and keep them clean until the acceptance of the completed work. Cap or plug ends of lines to prevent debris from entering during construction.

D. Make changes in direction of sanitary piping with approved sanitary fittings, Y branches, 1/8 or 1/16 bends.

E. In soil, waste, and vent stacks where branches occur that are smaller than stacks, provide properly sized reducing fittings.

F. Install all sanitary piping at a 2 percent minimum downward slope in the direction of flow unless otherwise indicated.

3.3 INSTALLING CAST-IRON PIPING

A. 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." Install restraint assemblies at pipe couplings and fittings for piping NPS 5 (DN 125) and larger.

3.4 CONNECTIONS TO EXISTING MANHOLES

A. Where new connections are made to existing manholes, or where connections are altered, cut existing manhole walls and install new brick-lined or clay-tile-lined channels, securely embedded in cement mortar.

3.5 CONNECTING TO EXISTING PIPING

A. Clean the inside of existing piping at connections to new piping using a water blasting device.

B. Blasting device: Flexible high pressure hose with self-propelling nozzle which blasts to front, sides, and rear (propulsion).

C. Operation: Blasting device is operated with water at 15,000 psi (10^7 kPa). The piping system being cleaned is not pressurized.

D. Clean from the connection point to at least 5 feet (1.5 m) outside the exterior building wall.

3.6 SCHEDULES

A. Sanitary pipe installation schedule.

Application	Cast-iron hub and spigot	Cast-iron no-hub	Copper tube (DWV)
Sanitary, exterior or below slab on earth	X		
Miscellaneous drains from equipment		X	

END OF SECTION 221316

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SECTION 221413 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Storm water piping.

1.2 RELATED SECTIONS

A. Piping installation and testing: Section 220500.

B. Storm water piping specialties: Section 221423.

1.3 REFERENCES

A. Cast iron piping standards

1. ASTM A 74: Standard Specification for Cast Iron Soil Pipe and Fittings
2. ASTM C 564: Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
3. ASTM C1540: Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings
4. CISPI 301: Standard Specification for hubless cast iron soil pipe and fittings for sanitary and storm drain, waste, and vent piping applications

1.4 SUBMITTALS

A. Product data: Each specified material and product.

B. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

1.5 QUALITY ASSURANCE

A. Cast iron pipe and fittings shall be marked with the collective trademarks of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.

B. Prior to any new piping installation, the Contractor shall verify the inverts of all piping to which new work is to be attached. The Contractor shall demonstrate to the satisfaction of the construction manager and/or Owner, that the connections to existing storm water pipes meet the intent of the contract.

C. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label, directly on the pipe, indicating compliance.

D. After all new construction is complete, all underground pipes sized 2 inches in diameter and above shall be inspected via video camera and digitally recorded for turnover to Owner.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Install each type of pipe and fittings in locations required or permitted in Part 3, including the Pipe Installation Schedule at the end of the section.

B. Cast-iron hub and spigot pipe and fittings:

1. Pipe: ASTM A 74 service class
2. Neoprene gaskets joints:

a. Lifetime ASTM C 564 neoprene gasket joints
b. Basis of design: Fernco “Multi-Tite”, Tyler Pipe “Ty-seal”, or Mission Rubber “Mission-Tite.”

C. Cast-iron no-hub pipe and fittings:

1. Pipe and fittings: Cast Iron Soil Pipe Institute Standard 301.
2. Joints: Use one of the no-hub coupling options below

a. Option 1 (for use in any location):

(1) ASTM C 564 neoprene gaskets and two-piece cast-iron housing clamps and stainless-steel bolts and nuts.
(2) Basis of design: MG Piping Products Company.

b. Option 2 (for use in any location):

(1) Corrugated 304 stainless-steel shields with four or six clamps and holding bolts conforming to ASTM C 1540 and rubber gasket sealing sleeves conforming to ASTM C 564
(2) Basis of design: Husky “Series 4000” coupling or Mission "Heavy Weight Series CHW" coupling.

PART 3 - EXECUTION

3.1 PREPARATION

A. Connect piping as shown on the drawings. Check elevations of connection points before installing new work.

3.2 INSTALLATION, GENERAL

A. Use suitable tools and appliances for the safe and convenient handling and laying of pipe. Examine each section of pipe for defects. Do not lay any piece that is known to be defective. If any defective piece should be discovered after having been laid, remove and replace it at no change to the contract price.

B. Install piping in accordance with the Pipe Installation Schedule at the end of this section, as indicated on the drawings, and in accordance with Section 22 0500, Common Work Results for Plumbing. Materials and work shall conform to local plumbing codes and health department regulations.

C. Thoroughly clean all pipe and fittings before installing them, and keep them clean until the acceptance of the completed work. Cap or plug ends of lines to prevent debris from entering during construction.

D. Make changes in direction of storm water piping with approved sanitary fittings, Y branches, 1/8 or 1/16 bends.

E. Install all storm water piping at a 2 percent minimum downward slope in the direction of flow unless otherwise indicated.

F. Seal air-conditioning condensate drain where it passes through outside wall and provide splash block if required.

3.3 INSTALLING CAST-IRON PIPING

A. 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." Install restraint assemblies at pipe couplings and fittings for piping NPS 5 (DN 125) and larger.

3.4 SCHEDULES

A. Storm water pipe installation schedule.

Application	Cast iron hub & spigot	Cast iron no-hub	Copper tube (DWV)	Copper Type L or M
Storm water, exterior or below slab on earth	X			

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Leader shoes.

1.2 RELATED SECTIONS

A. Storm water piping: Section 221413.

1.3 SUBMITTALS

A. Product data: Each specialty device or equipment, with installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General: Model numbers are provided in the articles below to set a standard for materials, quality of construction, options and details, and performance. Provide named products, or equal products by the acceptable manufacturers listed.

2.2 LEADER SHOES

A. Leader shoe:

1. Cast-iron, conforming to downspouts shown on architectural and mechanical drawings.
2. Basis of design: Neenah Foundry Company Catalog No. R-4924 through R-4928.

PART 3 - EXECUTION

3.1 INSTALLING LEADER SHOES

A. Install leader shoes complete with cleanout, as indicated on drawings.

END OF SECTION 221423

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SECTION 224714 – ANIMAL DRINKERS

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 animal drinkers and related components.

1.3 RELATED SECTIONS

A. Section 22 0523 – General Duty Valves for Plumbing Piping.

B. Section 22 1116 – Domestic Water Piping.

C. Section 22 1316 – Sanitary Waste and Vent Piping.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of animal drinker.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include operating characteristics, and furnished specialties and accessories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For drinking fountains to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 ANIMAL DRINKERS

A. Animal Drinkers

1. Drinkers, Antifreeze:

2. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Nelson Manufacturing; www.nelsonmfg.com ; 888-844-6606
   b. ARGI Sales, Inc.; www.agrisales-inc.com ;

3. Provide the following Animal Drinkers, as located on drawings:
   Hornbill Stalls:
   a. Nelson Model 730-10 Wall mount with Optional Heater Kit

4. Standard: Comply with NSF 61.
5. Designed to operate without draining into ground.
6. Pedestal: Rectangular, painted cast iron or steel.
7. Receptor: Rectangular, chrome-plated brass or stainless steel with bubbler.
8. Supply Fittings: Underground shutoff and flow-control valve assembly.
9. Bury Depth, Grade to Valve Components: 36 inches.
10. Supply Piping: per manufacturer's recommendations

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and any sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to drawings and per manufacturer's instructions.

B. Set pedestal animal drinkers on concrete slabs.

C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping." Install "Heat Tracing for Plumbing Piping" as specified in Section 220533.

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings.

G. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball, gate, or globe shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

3.5 CLEANING

A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

END OF SECTION 224714

SECTION 230101 - HVAC GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for all HVAC work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

B. Commissioning requirements: Division 01.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers.

B. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 23.

B. Visit the site and study all aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of all labor, equipment and materials, and the performance of all operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for, including all necessary signatures and paperwork, all permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Owner.

E. HVAC work of this project includes, as a brief general description, the following:

1. Installation of new temperature sensor to monitor ambient conditions within kudu stalls. Temperature sensor to be connected to the main building automation system serving the Cheetah Conservation Station – African Trail site.

2. The project includes commissioning under the direction of a Commissioning Agent (CxA).

F. See Division 01 for requirements related to Owner's occupancy of the premises, limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 23 specifications.

B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for all coordination and additional costs as specified in the article "Substitutions," below for substitutions.

C. Products specified by reference standards or by description only: Any product meeting those standards or description.

D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance.

1. Where other acceptable manufacturers are named, Contractor may provide products of those named manufacturers only, which meet the specifications.
2. Where specification permits "equal" products, without naming other acceptable manufacturers, Contractor may use products of any manufacturer, which meet the specifications.

E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 23 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project, and of representative manufacture. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. All equipment, construction and installation must meet requirements of local, state and federal governing codes.

C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

1. Furnish: Supply item
2. Install: Mount and connect item

3. Provide: Furnish and install.

E. All materials and equipment shall be installed and completed in a first class and workmanlike manner and in accordance with the best modern methods, practice and manufacturers' instructions. Any work which shall not present an orderly and neat or workmanlike appearance shall be removed and replaced with satisfactory work when so directed in writing by the Architect.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall workmanship.

G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the Architect will determine sizes to be utilized.

H. In all cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the Architect of said uncertainty, doubt, or conflict and obtain a decision as to the intent before starting any work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the Architect and await a written decision.

B. Plan and coordinate all work to proceed in an orderly and continuous manner without undue delay, and in conformance with project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate HVAC work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of all piping, ductwork, light fixtures, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor's responsibility to bring this to the attention of the Architect prior to initiation of work. Correct improperly coordinated installation at no additional cost.

E. The Contractors' assistants shall include a competent foreman, who shall be on the premises at all times to check, lay out, coordinate and superintend the installation of work. The foreman shall establish all grades and lines relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers' and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for all equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of shop drawings and product data for every item of equipment. Shop drawings or product data will not be considered until manufacturers' lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor's name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.
3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.

4. All exclusively electrical items furnished as items associated with mechanical items but not specifically described in the mechanical item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the mechanical item by identification specification paragraph.
5. Product data sheets shall be 8.5-inches by 11-inches cut sheets for operating and maintenance manual.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of owner's representative, and project type and size.

E. After the work is completed, submit all required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the Architect prior to final acceptance of the work.

1.10 SPECIALIST

A. The term "Specialist" as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer's direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:

a. Contract drawings.
b. Specifications.

c. Addenda.
d. Change orders and other modifications to the Contract.
e. Reviewed shop drawings, product data, and samples.

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:

   a. Manufacturer's name and product model and number.
   b. Product options, substitutions, or alternates utilized.
   c. Changes made by addenda and modifications.

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:

   a. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   b. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
   c. Field changes of dimension and detail.
   d. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.
2. Binders: Three-ring binders with vinyl-covered hard covers. Provide large enough binders, and sufficient quantity, that the required contents can be easily turned, removed, and reinserted.
3. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," and title of project. Print on spine of binder "O & M INSTRUCTIONS." If more than one binder is required, print covers and spines with volume numbers. Include in the front of every binder an index to all binders.
4. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

5. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.
6. Part 1: Directory, listing names, addresses, and telephone numbers of mechanical engineers; Contractor; mechanical subcontractors; and major mechanical equipment suppliers.
7. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

    a. List of equipment, including operating weight of each piece.
    b. Parts list for each component, including recommended spare parts list.
    c. Operating instructions.
    d. Maintenance instructions for equipment and systems.
    e. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

8. Part 3: Project documents and certificates, including the following:

    a. Shop drawings and product data.
    b. Photocopies of certificates.
    c. Photocopies of warranties and guarantees.
    d. Test reports: Copies of the results of all tests required under all sections of specifications.

9. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.
10. Submit final volumes revised, within ten days after final inspection.

1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The plumbing, mechanical, electrical, building, fire, and safety codes of the state and county or city in which the work is being performed.
2. The National Electric Code, NFPA 70 (NEC).
3. The National Fire Protection Association Code. (NFPA).
4. International Energy Conservation, Fire, Fuel Gas, Mechanical, and Plumbing Codes (ICC).

1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply. Products shall be certified by manufacturers to meet the requirements of referenced standards.

1. Federal Specifications (FS)
2. Military Specification (MS)
3. Military Standards (Mil. Std.)
4. Air Conditioning and Refrigeration Institute (ARI)
5. Air Movement and Control Association (AMCA)
6. Associated Air Balance Council (AABC)
7. American Association State Highway and Transportation Officials (AASHTO)
8. American National Standards Institute (ANSI)
9. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
10. ASME International (ASME)
11. American Society for Testing and Materials (ASTM)
12. American Society of Sanitary Engineering (ASSE)
13. American Water Works Association (AWWA)
14. International Code Council (ICC)
15. Manufacturer's Standardization Society of the Valve and Fittings Industry Inc. (MSS)
16. National Electrical Code, NFPA 70 (NEC)
17. National Electrical Manufacturer's Association (NEMA)
18. National Fire Protection Association (NFPA)
19. National Fuel Gas Code, NFPA 54
20. National Sanitary Foundation (NSF)
21. National Standard Plumbing Code (NSPC)
22. The Occupational Safety and Health Act (OSHA)
23. Piping and Drainage Institute (PDI)
24. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
25. Underwriters Laboratory Inc. (UL)

26. Maryland Occupational Safety and Health Act (MOSHA)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for all contents within these areas. Provide all security measures necessary for this area.

B. Area shall be maintained and shall be returned to original condition at the completion of the project.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.
5. Protect areas occupied by Owner's personnel or equipment.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair all damage or soiling to the complete satisfaction of the Architect; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, all at no addition to the Contract Sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer's recommended temperatures.

E. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.16 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.17 SECURITY REQUIREMENTS

A. Coordinate with the COTR for any owner related requirements.

1.18 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in "Cutting and Patching" below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the COTR and Architect in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.19 WARRANTY

A. All work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties specified in individual sections.

B. During the correction period, the Contractor shall begin correcting any work found to be not in accordance with the requirements of the Contract Documents within 4-hours of receiving written notice from the Owner. Provide detailed schedule for completion of work within 24-hours of receiving written notice from the Owner and revise schedule based on any Owner comments generated. Except as otherwise required in General Conditions and Division 01, the correction period is one year after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

   1. Service reports for warranty work shall be provided to the Owner

C. When use of the permanent equipment has been permitted for temporary heating or ventilation of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers' standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.20 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractors' and subcontractors' responsibilities are described in Division 01.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of work to be completed. Close superfluous openings and remove all debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the Architect.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and all materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.3 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or Architect finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, Architect and Owner shall each be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

3.4 COMMISSIONING

A. Comply with requirements of “Commissioning” in Part 1 above.

END OF SECTION 230101

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SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to more than one section of Division 23.

B. Identification of HVAC systems and equipment.

C. Treated wood lumber.

D. Operating instructions.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 230101.

B. Operation and Maintenance Manuals: Division 01 and Section 230101.

C. Commissioning requirements: Division 01 and Division 23.

1.3 REFERENCES

A. American Society of Testing and Materials
   1. ASTM D 635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
   2. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials

B. NFPA 70: National Electric Code

1.4 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

1.5 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed based on the use of the particular manufacturer’s products specified and scheduled on the drawings.

B. Products of other manufacturers that are listed under the article "Acceptable Manufacturers," or permitted as "equal," are permitted provided:

1. Product shall meet the specifications.
2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that render their use impractical, or cause functional fit, access, or connection problems.

1.6 SUBMITTALS

A. Certifications: Proof of operator and testing agency personnel qualifications as required for welding and brazing in the article "Quality Assurance" below.

B. Test reports: Field test results for each piping system as specified in Part 3 below.

1.7 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the plumbing, mechanical, electrical, building, fire, health and safety, and other applicable codes and regulations of the state, county or city in which the work is performed.

B. UL label:

1. Electrical control panels, equipment, materials and devices provided or installed as work of Division 23 shall be UL listed and shall bear a UL label.
2. Equipment, including custom assemblies, shall be listed and labeled as an assembly.
3. If a UL label is not available, the item shall be tested and labeled by a qualified nationally recognized testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70 (NEC).
4. Provide testing, if required, without addition to the contract sum.

C. Products shall contain no urea-formaldehyde content.

1.8 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent. Contractors' and subcontractors' responsibilities are described in Division 01.

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment that uses or processes date and time data in order to perform its function shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

2.2 IDENTIFICATION DEVICES AND MATERIALS

A. Equipment identification tags:

1. Laminated plastic with adhesive back, white core and black outer layers, which, when engraved, will produce white letters and numerals on a black background.
2. Tags installed on curved surfaces shall be aluminum or brass.

2.3 TREATED WOOD LUMBER

A. Wood-preservative-treated lumber: Treated by pressure process, AWPA C2, with chemicals acceptable to authorities having jurisdiction, and marked with treatment quality mark of an inspection agency approved by ALSC Board of Review.

PART 3 - EXECUTION

3.1 GENERAL

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify COTR and Architect if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

B. The contract drawings are diagrammatic and do not indicate all access panels, or all specialties required. Provide required access panels, and specialties to coordinate the work.

C. Items which require access for operation or maintenance shall be easily accessible. Do not cut or form hand holes for operation or maintenance of appliances through walls or ceilings.

D. Provide installations compliant with NFPA 70.

3.2 IDENTIFICATION

A. General: Do not apply identification until finish painting work is complete.

B. Equipment:

1. Provide identification tags with minimum two-inch (50-mm) -high letters. Clearly indicate equipment designation and area served.
2. Firmly fasten each identification tag to its appropriate piece of equipment. Do not interfere with operation of, or damage the item being marked.

3.3 CLEANING AND PAINTING

A. Cleaning: Clean all equipment.

3.4 TREATED WOOD LUMBER

A. Provide wood-preservative-treated lumber where wood members are required as detailed on the drawings and in the following applications:

1. Cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.
2. Sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.

3.5 OPERATING INSTRUCTIONS (DEMONSTRATION)

A. Furnish the necessary technicians, skilled workers, and helpers to operate all the HVAC systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of all systems and equipment.

1. Instructions by manufacturer's technical representative for each type of equipment shall include the performance of the recommended preventive maintenance procedures for that equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions, for use by instructors and Owner personnel.

E. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Architect.

END OF SECTION 230500

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SECTION 230504 - HVAC DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Extent and location of demolition are shown on the drawings.

1.2 RELATED SECTIONS

A. Demolition: Division 02.

B. Asbestos removal: Division 02.

1.3 REFERENCES

A. ANSI/ASHRAE Standard 147: Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems.

1.4 QUALITY ASSURANCE

A. Demolition shall be carried out as expeditiously as possible in accordance with accepted practice and applicable building code provisions.

1.5 PROJECT CONDITIONS

A. If, in the course of the work, workers encounter a material they suspect to be asbestos, to contain lead or PCBs, or to present some other hazard:

1. Promptly notify the Owner and Architect in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

B. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.

C. Locate, identify, and protect mechanical and electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before beginning to remove equipment, which contains refrigerants, remove refrigerants.

1. Following the recommendations of ANSI/ASHRAE Standard 147 and requirements of local authorities having jurisdiction, and using approved equipment, recover refrigerants.
2. Store each type of refrigerant in a separate container which meets requirements for refillability.
3. Handle and store following the recommendations of ANSI/ASHRAE Standard 147.

3.2 DEMOLITION

A. Comply with demolition and disposal requirements of Division 02.

B. Perform removal work neatly with the least possible disturbance to the building.

C. Provide temporary barriers, danger signals, and appurtenances for protection of personnel and equipment during removal operations.

D. Demolish, remove, demount, and disconnect inactive and obsolete piping, fittings and specialties, equipment, ductwork, controls, fixtures, and insulation.

1. Piping and ducts embedded in floors, walls, and ceilings may be abandoned in place if they do not interfere with new installations. Cut back to at least one inch below finished surface.
2. Remove materials above accessible ceilings.
3. Drain and cap items to remain behind finished surfaces.
4. Patch and repair surface materials as required in Division 01 and Section 230101 article, “Cutting and Patching.”

E. Remove anchors, bolts, and fasteners associated with piping and equipment to be removed.

3.3 DISPOSAL

A. Dispose of equipment and materials removed, and rubbish and waste material, as work progresses. Do not allow demolition debris to accumulate on site. Remove products of demolition from the building daily.

3.4 PROTECTION

A. Provide adequate and positive protection to existing building and equipment that is to remain, particularly to prevent entry of either dust or water. Ensure weathertightness at all times. Keep standby patching materials on hand to patch and maintain protection as required.

END OF SECTION 230504

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SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Unless otherwise specified in a particular section or required for a particular application, motors shall conform to the following requirements, whether factory-installed or field-installed.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Motor capacitors: Section 260521, Wiring Connections.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Fans:

1. HVAC fans: Section 233400.

B. Unit heaters:

1. Unit heaters with coils: Section 238239.

1.4 REFERENCES

A. NEMA MG 1: Motors and Generators.

B. NEMA MG 10: Energy Management Guide for Selection and Use of Polyphase Motors.

C. NEMA MG 11: Energy Management Guide for Selection and Use of Single-Phase Motors.

D. UL 508: Industrial Control Equipment.

1.5 DEFINITIONS

A. Energy efficient motor: Motor meeting the nominal and minimum efficiency levels listed for its horsepower and speed in Table 12-10 of NEMA MG 1.

B. Nominal efficiency: Efficiency as defined in Table 12-8, Efficiency Levels, in NEMA MG 1, and identified on the motor nameplate.

1.6 SUBMITTALS

A. Product data:

1. Motors and drives not provided with equipment: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lugs, and coatings.
2. Motor capacitors.

B. Wiring diagrams required for the proper installation of mechanical equipment.

C. Submit product data which verifies compliance with ASHRAE 90.1 or provide certified performance ratings by a qualified independent testing agency.

D. Certifications:

1. Actual motor power factor for each motor, certified test results for each motor proposed for use on this project.
2. Field test showing corrected power factor, if required.

1.7 QUALITY ASSURANCE

A. UL label: As specified in Section 230500, Common Work Results for HVAC.

B. Actual motor power factor shall be tested and certified by an independent testing laboratory.

C. Where power factor is field tested as required in “Power Factor” in Part 2 below, specialist performing tests shall be acceptable to the local authorities having jurisdiction.

D. HVAC equipment shall meet the energy performance requirements of ASHRAE 90.1.

1.8 REGULATORY REQUIREMENTS

A. Motors shall conform to the requirements of NEMA MG1 and applicable portions of the National Electric Code (NEC, NFPA 70).

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Motors:

1. Baldor Electric Co.
2. Marathon
3. Rockwell
4. Siemens
5. A.O. Smith
6. Toshiba International

B. Motor capacitors:

1. ABB Power Distribution
2. Commonwealth Sprague
3. General Electric

2.2 BASIC MOTOR REQUIREMENTS

A. Capacity: Each motor shall have sufficient capacity and torque to start, accelerate, and operate the machine it drives without exceeding the motor nameplate rating at the speed specified, or at any speed and load which may be obtained by the drive actually furnished.

B. Starting: Each automatically controlled motor shall be capable of starting as frequently as the control sequence may demand. Motors not automatically controlled shall be capable of making no fewer than 4 starts per hour.

C. Loads: Belt-connected motors shall be equipped with shafts and bearings designed to withstand both the normal connected loads of the drive furnished, and momentary loads imposed during acceleration.

D. Ratings: Motors shall be rated for continuous duty at 100 percent of rated capacity, and temperature rise shall be based on ambient temperature of 40 degrees C.

E. Phase: Unless otherwise indicated, motors one-half horsepower and larger shall be polyphase and motors smaller than one-half horsepower shall be single-phase motors.

F. Motor construction:

1. Motors for fans and pumps, unless specified otherwise in the equipment section, shall be open drip-proof NEMA design B construction.
2. Motors where indicated or specified, shall be totally enclosed, fan cooled (TEFC) extra severe duty.

G. Efficiency: The term "energy efficient" is defined in the article "Definitions" in Part 1 above.

1. Single-phase motors, alternating-current fractional horsepower, rated 1/20 to 1 horsepower, 250 volts or less: NEMA MG 11, types and efficiencies selected for their applications.
2. Polyphase motors, medium alternating-current, squirrel-cage, 1 to 500 horsepower, 600 volts or less: NEMA MG 10, energy-efficient types selected for their application. Nominal full-load efficiencies shall meet or exceed ratings of Table 12-10 of NEMA MG 1.
3. Motors for packaged hermetic and semi-hermetic refrigeration compressors need not comply with these efficiency requirements but they shall comply with the requirements indicated for power factor and power consumption.

2.3 SINGLE-PHASE MOTORS

A. Permanent split-capacitor or split-phase type.

B. Bearings: Sealed, prelubricated ball-bearing type.

2.4 POLYPHASE MOTORS

A. NEMA MG1 Design B.

B. Stator: Copper windings.

C. Rotor: Squirrel cage.

D. Bearings: Doubly shielded, prelubricated ball bearings suitable for radial and thrust loading of connected equipment.

E. Temperature rise shall not exceed insulation rating.

F. Insulation: Class F.

G. Motors used with inrush controllers: Match wiring requirements for indicated controller with required motor leads brought to motor terminal box to suit control method.

H. Horsepower/frame relationship: NEMA Standard for T frame motors.

I. Motor frame and endshields: Cast iron.

J. Conduit box: Either steel or aluminum, diagonally split and rotatable in 90-degree increments, with grounding provision.

K. Finishes:

1. External hardware: Plated to resist corrosion.
2. External paint: Industrial enamel.

L. Nameplates: Stainless steel or aluminum, and stamped in accordance with NEMA MG1. Nameplate information shall include the nominal efficiency value in accordance with NEMA MG1 and the manufacturer's minimum guaranteed efficiency value.

2.5 ELECTRONICALLY COMMUTATED MOTOR (ECM)

A. Brushless direct current (DC) variable speed motor supplied with alternating current, with a permanent magnet with near zero rotor losses, permanently-lubricated ball bearings, electronic commutation, designed for synchronous rotation, and at least 70 percent efficient at all operating speeds.

B. As a minimum, the motor shall include the following features:

1. Integrated controller / invertor that operates the wound stator and senses rotor position to electronically commutate the stator.
2. Thermal overload protection.
3. Built-in soft start and soft speed change ramps.
4. Inductors to minimize harmonic distortion and line noise.
5. Designed to overcome reverse rotation without affecting life expectancy.
6. Motor speed shall be controllable down to 20 percent of full speed. Speed shall be controlled by either a potentiometer with manual adjustment on the motor or by a 0-10Vdc analog signal from a remote source, as required by other sections of Division 23 specifications.
7. Software for motor control shall be as indicated or described in other Division 23 specifications.

2.6 TOTALLY ENCLOSED FAN-COOLED (TEFC) MOTORS

A. Polyphase motors with the following additional requirements:

1. TEFC construction for severe environment.
2. Ventilating fans: Made of corrosion-resistant, non-sparking material.

3. Conduit box: Heavy-wall cast construction, gasketed with a lead gasket between box and motor frame.
4. Motor shaft shall be provided with an external slinger on the drive end.
5. Rotor and stator air-gap surfaces coated to prevent corrosion.
6. Finish: At least two coats of catalyzed epoxy enamel.

B. Explosion-proof motors: TEFC NEMA Type K and NFPA hazardous Class I or Class II as required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount direct-connected motors securely and in accurate alignment. The drive shall be free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

B. Provide each belt-connected motor with a securely mounted adjustable base to permit installation and adjustment of belts.

C. Mount capacitors shipped separately beside motor connection box as required. Connect in accordance with the requirements of Division 26, Electrical.

1. Test units at full rated load after the installation of the motor capacitors, and submit reports.

D. Provide explosion-proof motors where indicated.

E. Provide additional drive and belt changes where required to meet requirements of testing and balancing specified in Section 230593, Testing, Adjusting and Balancing.

3.2 OPERATING INSTRUCTIONS

A. As specified in Section 230500, provide operating instructions.

END OF SECTION 230513

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The Contractor shall engage and the Architect shall approve an independent balancing and testing subcontractor.

B. This section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow within distribution systems to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC equipment.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
6. Reporting results of the activities and procedures specified in this section.

1.2 RELATED SECTIONS

A. Testing and adjusting requirements unique to particular systems and equipment are included in the sections that specify those systems and equipment.

B. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment sections.

1.3 PERFORMANCE REQUIREMENTS

A. Select and obtain approval of the testing and balancing subcontractor at the earliest possible time and before beginning ductwork installation.

B. The testing and balancing subcontractor shall visit the job site periodically, beginning with the initial stages of construction of the mechanical systems, and shall ensure that the necessary devices are properly installed so that specified testing and balancing can be performed.

1.4 SUBMITTALS

A. Submit qualifications of testing and balancing subcontractor, as required in article “Quality Assurance” below.

B. Submit certified balance report. In addition to general requirements for submittals, submit three copies of final reports and certificates, bound into a booklet.

1.5 QUALITY ASSURANCE

A. Testing and balancing subcontractor qualifications:

1. Current certified member of the Associated Air Balance Council, or certified by National Environmental Balancing Bureau for air and hydronic systems testing and balancing.
2. Has successfully completed at least five projects of similar size and scope.
3. Not affiliated with any other subcontractor participating in this project. Work performed by the subcontractor shall be limited to testing, adjusting, and balancing HVAC systems.

B. Testing and balancing work shall comply with one of the following standards:

1. National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning Systems, published by the Associated Air Balance Council.
2. Procedural Standards for Testing Adjusting Balancing of Environmental Systems, published by the National Environmental Balancing Bureau.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Instruments: Approved and properly calibrated.

PART 3 - EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Before beginning balancing, ascertain that systems are ready. Verify that filters for regular service are in place, as required in Section 234100, Particulate Air Filtration.

3.2 PREPARATION

A. Witness air duct leakage tests required in Section 233113, Metal Ducts, and advise and approve the methods and instruments used.

B. Using bench-calibrated instruments, field-calibrate pressure gages and dial-type duct thermometers.

3.3 BALANCING OF SYSTEMS, GENERAL

A. Tabulate settings of temperature control devices and ascertain that thermostats, controllers, are set at specified or approved positions. Verify and certify that the sequence of operation for each system is as shown on drawings, specified, or approved.
B. Provide all labor and devices necessary for the testing and balancing work.

3.4 AIR SYSTEMS BALANCING

A. Balance all air distribution, exhaust, and outdoor air systems and equipment.

B. Test and adjust fans to deliver design airflow at lowest possible speed. Note that air quantities scheduled on drawings do not include allowances for duct leakage. Preliminary adjustments of fan speed should be slightly in excess of scheduled airflow delivery. Make adjustments by adjusting adjustable sheaves, changing sheaves and associated belts, changing wiring connections of motors, or adjusting speed controller.

C. Test and adjust system to design airflow requirements to the greatest extent possible.

D. Adjust rooms or zones to design airflow (outdoor and exhaust).

E. Adjust general HVAC systems to design airflow within the following tolerances:

1. Total system exhaust: (design to plus 10 percent).
2. Outdoor air: (minus 5 percent to plus 5 percent).
3. Total exhaust for a room or space: (minus 5 percent to plus 5 percent).

F. In cooperation with the control manufacturer’s representative, set adjustments of automatically operated dampers to operate as specified.

END OF SECTION 230593

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SECTION 230901 - AUTOMATIC TEMPERATURE CONTROL SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Extension of existing automatic temperature control (ATC) system.

B. Sequences of operation for automatically controlled equipment are shown on drawings. ATC subcontractor shall cooperate with the unit suppliers and provide all relays and wiring required to integrate the sequence of operation.

1.2 RELATED SECTIONS

A. Controls: Sections 230901 through 230913.

1.3 SYSTEM DESCRIPTION

A. Provide an extension of existing system of direct digital temperature controls with electronic and/or electric actuation.

B. The system shall consist of two levels of network communication and wiring, DDC controllers, application-specific controllers, software, operator I/O devices, sensors, and other necessary input hardware, and other necessary output hardware, , electrical power surge protection, other necessary equipment and a complete system of wiring to fulfill the intent of the sequences of operation shown on the drawings.

C. The existing system diagrams are available through the Owner.

1.4 DESIGN REQUIREMENTS

A. The products specified, scheduled, and shown on drawings are the basis of the design of this project.

B. For requirements affecting use of optional manufacturers, or substitutions, see Division 01 and Section 230101, HVAC General Provisions, and Section 230500, Common Work Results for HVAC.

1.5 SUBMITTALS

A. Shop drawings: Provide a point schedule and composite control diagram of all equipment provided for each control sequence, including factory and field controls. Include a written description of sequences, in which each control device or item of equipment is identified by the designation indicated on the diagram.

B. Product data: See individual controls sections.

C. Certifications:

1. Factory authorization and certification of the installing company.
2. Evidence of training and certification of each supervisor and mechanic assigned to this project.

D. Project record documents: As specified in Division 01 and Section 230101, provide a drawing at the same scale as the contract drawings, showing the locations of all components installed.

1.6 QUALITY ASSURANCE

A. Qualified subcontractor shall prepare control diagrams.

B. Perform work in accordance with the plumbing, electrical, building, fire and safety codes of the state, county, or city in which the work is performed.

C. UL label: As specified in Section 230500, Common Work Results for HVAC.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Electric, electronic, or direct digital system:

1. Siemens Building Technologies, Inc. - Landis Div.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Coordinate with equipment suppliers to integrate controls provided by manufacturers into the control sequences shown on drawings.

B. Mount devices and control panels provided by equipment manufacturers, and provide required control wiring.

C. Operate, test, calibrate, and adjust each control system until it operates as intended by the manufacturer and as specified in the control sequence.

3.2 TESTS

A. Thoroughly test and check the completed system to ascertain that all equipment is functioning as intended. Installer of work of this section shall cooperate with the equipment suppliers, and with balancing and testing work, to make necessary adjustments to ATC devices for proper operation of the completed system.

3.3 OPERATING INSTRUCTIONS

A. As specified in Section 230500, provide operating instructions.

END OF SECTION 230901

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SECTION 230902 - CONTROL SYSTEMS WIRING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wiring for automatic temperature control system.

1.2 RELATED SECTIONS

A. Automatic temperature control system: Sections 230901 through 230913.

B. Control sequences: Shown on drawings.

1.3 SUBMITTALS

A. Product data: Wire, cable, conduit and fittings, disconnecting switches, and transformers.

1.4 QUALITY ASSURANCE

A. UL label: As specified in Section 230500, Common Work Results for HVAC.

B. Control system power circuits shall not supply power to other building components such as lights or receptacles.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Electrical materials and devices shall be UL listed and shall meet the requirements of NEC (NFPA 70) and Division 26, Electrical.

2.2 WIRING

A. Wiring 50 V and below: Fully color coded, copper 600 V type THW or THHN, minimum No. 22 or as specified in Division 26, Electrical.

2.3 CONDUIT AND FITTINGS

A. Galvanized steel conduit: Minimum size 0.5 inches (16 mm), hot-dip galvanized with threads galvanized after cutting, one of the following:

1. Rigid full weight, heavy-wall steel conduit (RGS) conforming to UL 6 and ANSI C80.01.
2. Intermediate steel conduit (IMC) conforming to UL 1242 and ANSI C80.03.

B. Steel conduit fittings: Cast malleable iron fittings with smooth finish and full threaded hubs. Include steel or malleable iron locknuts, bushings, and other fittings.

1. Insulating bushings.

   a. Basis of design: Thomas & Betts Series 22.

2. Hub fittings with recessed sealing ring and nylon insulated throat.

   a. Basis of design: Thomas & Betts Series 370.

3. Fittings for exposed locations: Conduit outlet bodies, zinc- or cadmium-plated.

C. Electrical metallic tubing (EMT):

1. Minimum size 0.5 inch (16 mm), maximum 1.5 inch (41 mm), hot-dip galvanized or sherardized thin-wall steel conduit conforming to UL 797 and ANSI C 80.03.
2. Connectors and couplings for EMT: Concrete- or rain-tight, compression or set screw type, made of cadmium-plated steel with nylon insulating throat.

   a. Basis of design: Thomas & Betts Series 5031, 5123 and 5120.

D. Flexible metal conduit:

1. Minimum size 0.5 inch (16 mm), made of sheet metal strip, interlocked construction, conforming to UL 1.
2. Connectors for flexible metal conduit: Angle wedge type with nylon insulated throat.

   a. Basis of design: Thomas & Betts Series 3110 and 3130, “Tite-Bite.”

E. Liquidtight flexible metal conduit:

1. Conform to UL 360.
2. Liquidtight connectors: UL 14814A, with fittings and nylon-insulated throat.

   a. Basis of design: Thomas & Betts Series 5331.

F. Surface metal raceway: Raceway dimensions 0.65 by 0.75 inches minimum size, complete with fittings, connectors, and accessories.

   a. Basis of design: Wiremold No. 700.

2.4 EQUIPMENT

A. Control transformer: Designed for power sources for 24-V ac control circuits, and precision built to ensure rated power, proper voltage regulation and maximum efficiency. Units shall be equipped with integral manual reset circuit breaker for over-current protection on the secondary winding. Output regulation shall be 10 percent from no load to full load.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Electrical equipment is specified in Division 26, Electrical. Include in the work of this section relays, pushbuttons, transformers, coils, power wiring, control wiring, or other equipment, meeting requirements of Division 26, so that the automatic temperature control system will function as specified and indicated on the drawings.

B. Control system power source:

   1. Equipment control applications other than terminal equipment:

      a. Applications include, but are not limited to, other non-terminal type equipment and systems.
      b. Do not use equipment power as a source for control system power. Controllers shall remain energized when the power circuit to the equipment is deenergized.
      c. Provide circuit breakers in panelboards and power circuits to power controllers.
      d. Provide switches at each control panel to serve as disconnects; a panel may consist of multiple controllers within a single enclosure. Each panel shall be fused together.
      e. Provide metal-oxide varistors to protect controllers.

   2. Servers, switches, and other central control system components:

      a. Provide circuit breakers in panelboards and power circuits to power central control system components.
      b. Provide UPS and surge protection.

3. Provide circuit breakers that match and are compatible with other breakers in a panelboard.
4. Provide optional standby power for controls that support equipment provided with optional standby power.

C. Conduit

1. Install conduit and wiring as specified in Sections 260519 and 260533.
2. Where necessary to connect conduit to motors or motor-driven equipment, or to attach conduit to fan housings or air-handling units which contain fans, use a 24-inch (610-mm) looped section of flexible metallic conduit.

D. Provide data systems, including outlets, cabling, and required infrastructure, to support the manufacturers' requirements.

E. Make each run of cable or conductor connecting two points with a single continuous piece of cable or conductor. Do not splice. Cable or conductor may be extended by use of suitable connectors if approved by the Architect.

F. Shielding:

1. All input, output, and communications wire is to be shielded except when specifically disallowed by the controller or end device manufacturer.
2. All shields on controller input and output wiring shall be terminated except when specifically disallowed by the controller or end device manufacturer. The shield must be terminated at the controller end only.
3. RS-485 communication shield wiring shall be continuous from one end of the trunk to the other and must only be terminated at the ‘originating’ router.
4. The shields (foil and drain wire) from individual wire segments at a controller must be twisted, and the free end of the shield taped back (using electrical tape) to one of the communication wires. A portion of the shield must be exposed to allow a technician to verify the continuity of the shield.

END OF SECTION 230902

SECTION 230905 - CONTROL PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDED

A. Control panels and accessories.

1.2 SUBMITTALS

A. Product data: Each type of control panel included in the project.

1.3 QUALITY ASSURANCE

A. UL label: As specified in Section 230500, Common Work Results for HVAC.

PART 2 - PRODUCTS

2.1 MECHANICAL ROOM CABINETS

A. Provide enclosed, lockable, 16-gauge steel cabinets, one located in each mechanical equipment room, which shall contain all controls which are not required to be mounted at the controlled device. Manual switches and indicating gauges for each switch shall be mounted inside the cabinet. Wiring and tubing in the panel shall be color-coded, and wiring shall be extended to numbered terminal strips.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Panels mounted on legs shall have the legs securely attached to floor with 0.25-inch lead anchors. Provide a 4-inch-high concrete base around legs and conduits leaving the panel where conduits pass into floor.

B. Panels attached to walls shall be secured with toggle bolts or anchors as required. Anchor plates shall be built into walls for large surface-mounted units.

END OF SECTION 230905

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SECTION 230913 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Control devices and accessories.

1.2 REFERENCES

A. UL 508: Standard for Industrial Control Equipment

1.3 SUBMITTALS

A. Product data:

1. For each device, indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes, and installation instructions.

B. Maintenance data: As required in Section 230101, HVAC General Provisions.

1.4 MAINTENANCE

A. Provide two sets of manufacturer's special tools for operating tamperproof fasteners, marked to identify their use. Deliver to the Owner's storage area as directed and obtain a signed transmittal.

B. Provide all keys to enclosures, thermostat guards and equipment marked to identify their use. Deliver to the Owner's storage area as directed and obtain a signed transmittal.

PART 2 - PRODUCTS

2.1 CONTROL DEVICES, GENERAL

A. Instruments with temperature set points shall be provided with a means of adjustment over a reasonable range.

B. Adjustable devices for temperature control shall be graduated and calibrated in degrees F. Markings such as WARMER and COOLER are not acceptable unless specifically required on the drawings.

C. Devices mounted outdoors shall be weathertight construction or mounted in weathertight enclosure or inside weathertight units.

2.2 TEMPERATURE DEVICES

A. Outside air temperature sensor (to be installed in animal stalls behind protective shield):

1. Nickel RTD temperature sensor with transmitter, sensing air temperature, with single point sensing element in rigid a protective sheath.
2. Temperature range: -40 to 140 degrees F (-40 to 60 degrees C).
3. Accuracy: ± 0.5 degrees F (0.3 degrees C).
4. Enclosure: NEMA 3R or NEMA 4X.
5. Basis of design: VAISALA.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Provide wiring between control devices, equipment, and controllers as required by sequences of operation and as scheduled on the Control Point Schedule.

B. Configure control devices to accomplish sequences of operation.

C. Calibrate control devices.

D. Coordinate with the Owner to establish set points for control devices.

E. Provide relays, switches, and accessories required for the successful operation of this system. Identify each switch with a nameplate.

F. Provide temperature sensors where indicated on drawings.

G. Provide insulated base plates for devices mounted on exterior walls.

H. Provide wall-mounted devices with mounting plates or junction boxes securely attached to the wall. Provide recessed junction boxes in finished spaces. Provide surface-mounted junction boxes in unfinished spaces. Securely anchor wall-mounted devices with tamperproof screws.

I. Mounting height from floor to top of control for wall-mounted devices with human interface in public areas shall be 48 inches (1220 mm), as required for accessibility to persons using wheelchairs.

J. Provide guards for wall-mounted devices where noted and where devices are subject to damage. Mount guard, or guard base, to wall with at least four tamperproof screws, entirely independent of device and its wall plate, cover, and electrical box.

K. Provide components and connective piping and tubing with pressure and temperature ratings that meet or exceed the service pressure and temperature of the associated system.

3.2 INSTALLING TEMPERATURE DEVICES

A. Outside air temperature sensor:

1. Provide in a location that is accessible and safe from damage, and where measurement is not influenced by adjacent equipment or exhaust air streams.
2. Provide transmitter in an accessible location.

3.3 INSTALLING ACCESSORIES AND AUXILIARY CONTROLS

A. Guard for wall-mounted thermostats, sensors, or other control devices: Provide where indicated on drawings and where required to protect devices from damage.

3.4 OPERATING INSTRUCTIONS

A. As specified in Section 230500, provide operating instructions.

END OF SECTION 230913

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SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. HVAC metal supply, return, and exhaust ductwork and plenums in pressure classes from -2 to +10 inches w.g. (-500 to +2490 Pa).

B. Shop-fabricated or factory-fabricated ducts and fittings:

1. Single-wall round duct.

C. Joint and sealing materials.

D. Air duct leakage testing.

1.2 RELATED SECTIONS

A. Firestopping: Division 07.

B. Balancing: Section 230593.

C. Duct accessories: Section 233300.

D. Louvers: Division 08 and as indicated on the drawings.

1.3 REFERENCES

A. ACGIH-01: American Conference of Governmental Industrial Hygienists

1. Industrial Ventilation: A Manual of Recommended Practice.

B. ASHRAE

1. ASHRAE Handbook of Fundamentals.

C. ASTM

1. ASTM E2336: Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems
2. ASTM G 21: Determining Resistance of Synthetic Polymeric Materials to Fungi.

3. ASTM G 22: Determining Resistance of Synthetic Polymeric Materials to Bacteria.

D. SMACNA

1. HVAC DCS: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
2. HVAC Air Duct Leakage Test Manual.

E. UL 181: Factory-Made Air Ducts and Air Connectors.

1.4 DEFINITIONS

A. Seam: Joining of two longitudinal (parallel to the direction of airflow) edges of duct surface material. All other duct surface connections are joints.

B. Joints: Transverse joints (perpendicular to the direction of airflow); branch and subbranch intersections; duct collar tap-ins; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Do not change the layout or configuration of the duct system except as specifically approved in writing. Accompany requests for modifications with calculations showing that the proposed design will provide the original design results without increasing system total pressure.

1.6 SUBMITTALS

A. Shop drawings:

1. Schedule of duct systems with applicable pressure classes and leakage classes.
2. Fabrication, assembly, and installation for each duct system: Indicate duct dimensions, sheet metal thickness, reinforcement spacing, and seam and joint construction; and components and attachments to other work.
3. Calculations required as specified in the article “System Performance Requirements” above.
4. Schedule of sealing methods for each type of seam and joint.

B. Product data:

1. Factory-fabricated ducts and fittings.

2. Joint and sealing materials.
3. Manufacturer's installation instructions.

C. Test reports: Air Duct Leakage Test Summary: Submit data on forms as indicated in the SMACNA HVAC Duct Leakage Test Manual. (See sample form at end of section.)

1.7 QUALITY ASSURANCE

A. Specified and scheduled duct construction exceeds SMACNA requirements. Comply with specifications and schedules, and for materials or methods not specified or scheduled, comply with SMACNA HVAC DCS and RIDCS.

B. Comply with NFPA 90A and 90B.

C. Where shop-fabricated ductwork and fittings are permitted, products shall meet or exceed the quality of material, quality of construction, and performance of the basis of design factory-fabricated product.

D. Where shop-fabricated ductwork and fittings are proposed, contractor shall provide a listing of ten comparable projects completed within the last five years using shop-fabricated ductwork and fittings of the type proposed as evidence of quality and performance.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide specified or noted products, or comparable product by one of the following:

1. Factory-fabricated ducts and fittings:

a. Eastern Sheet Metal
b. Hamlin Sheet Metal
c. LaPine Metal Products
d. Linx Industries
e. McGill Airflow Corp.
f. MKT Metal Manufacturing
g. Phoenix Metals
h. Semco Mfg. Inc.
i. SPIRAmir

2. Manufactured joint connectors:

    a. Ductmate Industries
    b. C.L. Ward & Family Inc.

B. Special use ducts and fittings: Scheduled manufacturers and named products are intended to set a standard for materials, quality of construction, and performance.

2.2 MATERIALS

A. Metal sheets:

1. Galvanized steel sheets: Lock-forming quality, ASTM A 653/A 653M, coating designation G90 (Z275).
2. Carbon steel sheets: Cold-rolled, ASTM A 366/A 366M, oiled matte finish.
3. Aluminum sheets: ASTM B 209, alloy 3003, temper H14.

    a. Ducts exposed to view: Standard one-side bright finish.
    b. Concealed ducts: Mill finish.

4. Stainless steel sheets: ASTM A 480/A 480M, Type 304.

    a. Ducts exposed to view: No. 4 finish on exposed surface.
    b. Concealed ducts: No. 2B finish.

B. Tie rods: Galvanized steel, minimum diameter 0.25 inch (6 mm) for ducts up to 36 inches (900 mm); 0.375 inch (9 mm) for ducts over 36 inches (900 mm).

2.3 SHOP-FABRICATED OR FACTORY-FABRICATED DUCTS AND FITTINGS

A. Single-wall, rectangular duct and fittings:

1. Fabricate according to SMACNA HVAC DCS.

B. Single-wall, flat lock longitudinal-seam round duct and fittings:

1. Fabricate according to SMACNA HVAC DCS.
2. Seam: Flat lock; snap-lock seam not permitted.

C. Single-wall, spiral round duct and fittings for concealed applications: Provide the following construction unless otherwise indicated for special applications,

1. Material: Galvanized steel.
2. Seams: Spiral lock seam.
3. Joint basis of design: Round fittings, McGill Airflow "Uni-Seal" fittings, lap and riveted/screwed and sealed.
4. Fittings for branch connections shall be conical type.
5. Centerline radius of elbows shall be 1.5 times the diameter.
6. Duct access door basis of design: Type AR-W.
7. Basis of Design: McGill Airflow "Uni-Seal" spiral duct with "Uni-form" fittings.

Single-Wall Round Duct Minimum Metal Thickness		
Duct Element	Steel Gauge	Aluminum Thickness
Ducts up to 14 inches diameter	26	0.032 inches
Ducts 15 through 26 inch diameter	24	0.040 inches
Ducts 27 through 36 inch diameter	22	0.050 inches
Ducts 37 through 50 inch diameter	20	0.064 inches
Ducts 51 through 60 inch diameter	18	0.071 inches
Ducts 61 inches and over (welded joints required)	16	0.090 inches
Fittings up to 36 inch diameter	20	0.064 inches
Fittings 37 to 50 inch diameter	18	0.071 inches
Fittings over 51 inches in diameter	16	0.090 inches

Single-Wall Flat Oval Duct Minimum Metal Thickness		
Duct Element	Steel Gauge	Aluminum Thickness
Ducts up to 24 inches wide	24	0.040 inches
Ducts 25 to 48 inches wide	22	0.050 inches
Ducts 49 to 70 inches wide	20	0.064 inches
Ducts over 70 inches wide	18	0.071 inches
Fittings up to 36 inch width	20	0.064 inches
Fittings 36 inch to 50 inch width	18	0.071 inches
Fittings over 50 inches in width	16	0.090 inches

2.4 JOINT AND SEALING MATERIALS

A. Flexible joint material for connections to vibrating equipment: Specified in Section 233300, Duct Accessories.

B. Duct joint and seam sealants: UL classified, fire-resistive, conforming to NFPA 90A and 90B, high pressure type (up to 10 inches (2490 Pa) SMACNA pressure class), the following products are the basis of design:

1. Indoor application: Hardcast “Iron Grip” (IG-601) brush-on water-based vinyl acrylic sealing mastic.
2. Outdoor application:

    a. Hardcast “Versa-Grip” (VG-102) brush-on indoor/outdoor water-based polyester/synthetic resin sealant with UV inhibitors.
    b. Hardcast “Aluma-Grip” (AFT-701) pressure sensitive sealant on a roll. Two-mil (0.05-mm) aluminum foil backing, peel-off release liner, 33-mil (0.8-mm) modified elastomeric butyl sealant (100 percent solids). To be used outdoors only.

3. Silicone sealant (clear): Dow Corning 795, ASTM C920, Type S, Grade NS, Class 25, single component, indoor/outdoor application, UV resistive.
4. Flange gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

PART 3 - EXECUTION

3.1 COORDINATION

A. Before fabricating ductwork, make field measurements and coordinate layout of ductwork shown on the drawings with building components and work of other trades. Resolve conflicts and obtain written approval for deviations before fabrication or buying ductwork.

B. Provide for and install backdraft dampers, duct accessories and similar equipment furnished under this or other sections of the specifications.

C. Coordination with other work:

1. Exterior wall penetrations: Flash ducts passing through exterior walls as detailed on the drawings.
2. Louvers: Slope ductwork down toward the louver. Provide connections as indicated below:

a. Ductwork connection full size of louver: Provide angles, flanges, or damper collars as required to connect the ductwork to the louver.
b. Ductwork connections smaller than the full size of the louver: Blank off any unused portion of the louver with double-wall insulated metal panels with metal faces constructed of the same material as the connecting duct, and 1.5 inch (38 mm) thick minimum fiberglass insulation. Seal edges of panel insulation with sheet metal channels. Connect ductwork to insulated metal panel with using angles or flanges.
c. Damper connection to louver: Provide metal angle or channel frames as required for mounting ATC dampers and manual dampers to louvers.

3. Electrical panels and equipment:

a. Do not install ductwork over electrical panels and equipment unless otherwise indicated.
b. Where ductwork must be installed over electrical panels and equipment, provide aluminum sheet metal drain troughs under piping with drains piped to a safe location.

3.2 INSTALLING METAL DUCTWORK

A. Dimensions indicated on drawings are outer dimensions of ducts. Dimensions indicated for double-wall ducts are outer dimensions of outer wall.

B. Construct ductwork using the Duct Construction Schedule on the drawings. Schedule includes duct system pressure class requirements, minimum sheet metal gauges, leakage allowances, and maximum reinforcement spacing. These requirements exceed the requirements of SMACNA HVAC DCS. Engineered duct systems using metal gauges or reinforcing less than required in the schedules on the drawings are not acceptable.

C. Material: Construct ductwork of galvanized steel, except where another material is noted on drawings or specified.

D. Joints: Provide one of the following duct joints, except where other criteria are noted on the drawings or specified. Snap-lock or flat-lock seams are not acceptable.

1. Joint connections constructed in accordance with SMACNA HVAC DCS,
2. Manufactured duct connection system basis of design: Ductmate Industries “Ductmate,” selected to assure compliance with leakage factors indicated on the drawings.

E. Where specific materials and seam and joint construction are specified for a specific application, all ductwork carrying any concentration of air for that application, no matter how dilute, shall be constructed according to the requirements of the application.

F. Provide duct systems complete with built-in accessories as specified herein, in other sections of the specifications, as indicated on the drawings, and, where not otherwise indicated, in accordance with SMACNA HVAC DCS.

G. Thoroughly clean duct and duct fittings before they are installed, and keep them clean until the acceptance of the completed work. Use a duct cap cover on all unfinished ends to prevent moisture, dirt particles, dust, and debris from entering the installed ductwork during construction.

H. Install metal ductwork neat in appearance. Interior surfaces shall be smooth and free of obstructions. Duct lines shall be true and smooth.

I. Contractor has the option to eliminate reducing transitions and extend ductwork full size, providing space is available and conflict with work of other trades does not occur.

J. Construct gravity duct systems (nonfan-powered), such as pressure relief ducts and transfer ducts, in accordance with SMACNA HVAC DCS minimum one inch pressure class unless otherwise scheduled.

K. Cross break or bead ducts of dimensions of 12 inches (305 mm) and over in pressure classes under 2 inches (500 Pa).

L. Single-wall plenums: Construct in accordance with SMACNA HVAC DCS.

3.3 SEALING DUCTWORK

A. Seal all longitudinal and transverse joints, seams, and connections with the following exceptions:

1. Sealant may be omitted from welded joints and seams provided duct leakage is within the required tolerance.
2. Sealant may be omitted from locking-type joints and seams (other than snap-lock and button-lock) in ductwork with a pressure class below 2 inches of water column (500 Pa) where permitted by code requirements and provided duct leakage is within the required tolerance.

B. Sealing leakage performance: Seal ductwork to meet duct leakage factors scheduled on the drawings.

C. Sealing procedures:

1. Prior to sealing, ductwork shall be clean and dry, free of oil or grease.
2. Apply sealant in accordance with the manufacturer's recommendations.
3. Allow time for sealant to dry or cure, in accordance with manufacturer's recommendations, before leak testing.

D. Sealant material:

1. Galvanized steel ductwork: Brush-on or pressure sensitive sealant, as applicable.
2. Aluminum ductwork: Silicone sealant.
3. Stainless steel and carbon steel ductwork: Not applicable.

3.4 AIR DUCT LEAKAGE TESTS

A. Continuously examine ductwork during construction to ascertain that it is sealed properly.

B. General test procedures:

1. Leakage test procedures shall be in accordance with SMACNA Leakage Test Manual.
2. After installation and prior to insulating, test all ductwork for air leakage. Ducts to be tested, test pressures, and leakage factors (maximum volume of leakage per 100 square foot (9.3 square meter) of duct surface area) shall be as scheduled on the drawings.
3. The ductwork quantity to be tested exceeds SMACNA leakage test manual recommendations.
4. Conduct tests before any equipment is connected that would be subject to damage from the test pressure. Provide temporary blank-offs or caps.
5. Notify parties whose presence is necessary for the test; and in all cases, the Architect and testing and balancing subcontractor in writing at least two normal work days prior to the actual test.
6. While system is under test pressure, survey joints for audible leaks. Mark leakage points, shut down blower, and make repairs. Retest after duct sealant has dried or cured.
7. If test duct sections exceed the allotted leakage levels, locate sources of leakage, make repairs and repeat test procedures until acceptable leakage levels are demonstrated.

END OF SECTION 233113
Leakage test form follows Section

PROJECT NAME _____ PROJECT NO. _____ PAGE _____ OF _____

AIR DUCT LEAKAGE TEST SUMMARY

AIR SYSTEM _____
FAN CFM (Q) _____

LEAKAGE CLASS (GL) _____
SPECIFIED TEST PRESSURE (Pt) _____
DUCT CONSTRUCTION PRESSURE CLASS (P_c) ____

DESIGN DATA				FIELD TEST DATA RECORD							
SUBJECT DUCT	SURFACE AREA (FT^2)	ALLOWABLE LEAKAGE		DIAMETER		PRESSURE "W.G."		DATE	PERFORMED BY	WITNESSED BY	ACTUAL CFM
		FACTOR (CFM/100 FT^2)	CFM (TEST SECTION)	ORIFICE	TUBE	DUCT	ACROSS ORIFICE				
TOTAL SYSTEM											
TEST SECTION(S)											

SECTION 233300 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Flexible joint fabric.

B. Bird screen.

C. Insect screen.

D. Dampers.

E. Duct clamps.

1.2 RELATED SECTIONS

A. Louvers: Division 08.

1.3 REFERENCES

A. ASTM E 2016: Standard Specification for Industrial Woven Wire Cloth.

B. SMACNA HVAC DCS: HVAC Duct Construction Standards, Metal and Flexible.

1.4 SUBMITTALS

A. Product data: Each type of duct accessory included in the project.

B. Shop drawings: Detail equipment assemblies and indicate dimensions, loadings, required clearances, method of field assembly, components, locations, and size of each field connection. Detail these accessories:

1. Special fittings installations.

1.5 QUALITY ASSURANCE

A. Work of this section shall comply with NFPA 90A and 90B, and SMACNA HVAC DCS.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers' names and specific products are described in the articles below to set a standard for materials, quality of construction, options and details, and performance. Provide named products, or equal products by other named manufacturers.

2.2 FLEXIBLE CONNECTIONS

A. Flexible joint fabric: Woven glass fabric with coating, complying with NFPA 701 for fire retardance and NFPA 90A for use in duct systems.

1. For use indoors:

   a. Coated with polychloroprene (DuPont "Neoprene"), 30 ounces per square yard (850 g per 0.8 square meter).
   b. Basis of design: Ventfabrics "Ventglas."

2. For use outdoors:

   a. Coated with DuPont weather-, sunlight- and ozone-resistant "Hypalon," 26 ounces per square yard (732 g per 0.8 square meter).
   b. Basis of design: Ventfabrics "Ventlon,"

2.3 SCREENS

A. Bird screen: ASTM E 2016, general industrial-use wire cloth, Grade C, medium light or heavier, nominal 0.5-inch (13-mm) mesh and 0.063-inch (1.6-mm) wire diameter, aluminum or stainless steel.

1. Frame: Removable, rewirable, of same material and finish as the duct or accessory to which it is installed.

B. Insect screen: ASTM E 2016, general industrial-use wire cloth, Grade C, medium light or heavier, T304 stainless steel, nominal 0.044-inch (1.12-mm) openings, 14 by 18 per inch (per 2.54 cm) mesh, 0.011-inch (0.28-mm) wire diameter, 67-percent open area.

1. Frame and fasteners: Removable, same material and finish as louver or accessory to which it is installed, and capable of screen replacements.

2.4 DAMPERS

A. Material:

1. Where aluminum duct is required by the specifications, dampers shall be all aluminum construction in lieu of galvanized steel.
2. Where stainless steel duct is required by the specifications, dampers shall be all stainless steel construction in lieu of galvanized steel.

B. Counterbalanced backdraft dampers:

1. Constructed with galvanized steel channel frame. Blades shall be 16-gauge minimum galvanized-steel with neoprene blade seals and neoprene jamb seals, maximum width 7 inches, mounted on a steel shaft with ball bearings. Field adjustable counterbalance. Frame shall have a rust-inhibitive coating applied at the factory.
2. Basis of design: Ruskin Type CBS7.

2.5 DUCT CLAMPS

A. Duct clamps for flexible duct and flexible fabric connections: Positive locking drawbands able to conform to any shape. Fabricate from a single piece of stainless steel, with hex screw and worm gear.

B. Nonmetallic duct clamps for flexible duct connections:

1. Heavy-duty adjustable nylon strap type for 12-inch (305-mm) diameter and smaller flexible ductwork, complying with UL 181.
2. Basis of design: HellermannTyton Corporation

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Duct accessories shall be mounted or installed properly in accordance with the manufacturer's instructions and as indicated on the drawings.

3.2 INSTALLING FLEXIBLE CONNECTIONS

A. Flexible connections: Install using flexible joint fabric where duct connects to motor-driven equipment, and in other locations shown on drawings. Securely clamp flexible connection to duct and collar with duct clamps, providing 1 inch (25 mm) slack. Stitch seams with fiberglass thread.

1. Nonmetallic clamps: Install in accordance with manufacturer's recommendations, using manufacturer's special tools.
2. Flexible connections are not required where duct connects to air-handling equipment with internally isolated fans.

3.3 INSTALLING SCREENS

A. Install bird and insect screens in outdoor air and exhaust air connections.

B. Install bird screen at open ended duct terminations and where indicated on mechanical drawings.

3.4 INSTALLING DAMPERS

A. Install dampers at locations indicated on drawings and where required to properly balance the systems and to deliver the air quantities indicated. Each damper shall have substantial operators of proper size with locking facilities.

END OF SECTION 233300

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Propeller unit heaters.

1.2 RELATED SECTIONS

A. Motors: Section 230513.

B. Supports: Section 230529.

C. Controls: Sections 230901 through 230923.

D. Filters: Section 23 4100.

E. Electric-resistance unit heaters: Section 238238.

1.3 SUBMITTALS

A. Product data: Each type of heater included in the work.

B. Samples: Color chips for finish selection, manufacturer's complete line of colors and textures.

C. Unit shown on drawings is based on the dimensions of the design basis unit specified in Part 2 below. If another acceptable manufacturer's unit should be proposed, ascertain that it will fit in the available space. Include, if necessary, scale drawings similar to the contract drawings, including plans, elevations, sections, and diagrams, showing any changes in wiring, arrangement, or access necessary to accommodate the proposed unit. Show complete dimensions of complete assembled unit with accessories.

D. Submit product data which verifies compliance with ASHRAE 90.1, or provide certified performance ratings by a qualified independent testing agency.

1.4 QUALITY ASSURANCE

A. UL label: As specified in Section 230500, Common Work Results for HVAC.

B. HVAC equipment shall meet the energy performance requirements of ASHRAE 90.1.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the scheduled Modine units, or comparable product by one of the following:

a.

1. Propeller unit heaters:

a. Airtherm Manufacturing Company
b. Daikin Industries
c. Rittling
d. Sterling
e. Trane Company
f. Vulcan Radiator Corporation
g. Modine

2.2 PROPELLER UNIT HEATER

A. Type, capacity, and current characteristics are indicated on the drawings.

B. Casing: Steel, phosphatized and finished with baked epoxy powder coating.

1. Horizontal units: Furnished with double-deflection louver to allow for horizontal and vertical deflection of air pattern.
2. Vertical units: Diffuser shall provide widespread discharge air pattern.

C. Heat exchanger: Fluid-to-air type consisting of steel tubes with roll-formed aluminum fins and be vacuumed charge. The heat exchanger shall be filled to design level with a blend of long-life solution of propylene glycol, water and corrosion inhibitors.

1. Heat exchanger shall have a minimum of three heavy-duty immersion heating elements. Elements shall consist of high-quality resistance wire embedded in a compacted magnesium oxide refractory and sheathed in metal tube.
2. Heat exchanger shall be rated to meet capacity characteristics as indicated on the drawings.
3. Heat exchanger shall be protected by a preset 100 psig pressure-relief valve.
4. Heater is to be protected by a snap-action bimetal temperature high-limit cutout rated for 100,000 cycles.

D. Fan: Directly connected to single-speed electric motor and provided with wire guard. Motors shall comply with requirements of Section 230513.
E. Basis of design: Modine Explosion-Proof Horizontal Electric Heater (HEX)

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate with work of other trades to ensure that substrates meet requirements for installation tolerances and other conditions.

3.2 INSTALLATION, GENERAL

A. Install unit as shown on drawings, according to manufacturer's instructions, and in accordance with NFPA 90A.

B. Set each unit plumb and level and ensure that coils drain properly.

C. Install securely fastened in place.

3.3 INSTALLING PROPELLER UNIT HEATERS

A. Suspend from structure above with hanger rods not less than 0.5 inch in diameter.

B. Install in a manner and, if necessary, with vibration control devices so that vibration is not transmitted to the structure.

END OF SECTION 238239

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SECTION 260101 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for electrical work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

B. Commissioning requirements: Divisions 01 and 23.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers.

B. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 26.

B. Visit the site and study aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of labor, equipment and materials, and the performance of operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for necessary signatures and paperwork, permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Owner.

E. Electrical work of this project includes, as a brief general description, the following:

1. Removal of existing electrical power distribution equipment, luminaires, and wiring.
2. Provision of feeder and distribution equipment.
3. Wiring with luminaires and devices for refurbished building.

4. The project includes commissioning under the direction of a Commissioning Agent (CxA).

F. See Division 01 for requirements related to commissioning, Owner's occupancy of the premises, limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 26 specifications.

B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for coordination and additional costs as specified in article "Substitutions" below for substitutions.

C. Products specified by reference standards or by description only: Any product meeting those standards or description.

D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance, and shall not be construed as limiting competition. Contractor may use products of any manufacturer, which meet the specifications.

E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 26 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project, and of representative manufacturer. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. Equipment, construction and installation must meet requirements of Smithsonian Institution governing codes.

C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

1. Furnish: Supply item
2. Install: Mount and connect item
3. Provide: Furnish and install

E. Materials and equipment shall be installed and completed in a first class and professional manner and in accordance with the best modern methods, practice and manufacturers' instructions. Any work which shall not present an orderly and neat or professional appearance shall be removed and replaced with satisfactory work when so directed in writing by the COTR.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall artisanry.

G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the COTR will determine sizes to be utilized.

H. In cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the COTR of said uncertainty, doubt, or conflict and obtain a decision as to the intent prior to initiating any work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the COTR and await a written decision.

B. Plan and coordinate work to proceed in an orderly and continuous manner without undue delay, and in conformance with the project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate electrical work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of raceway, luminaires, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor's responsibility to bring this to the attention of the COTR prior to initiation of work. Correct improperly coordinated installation at no additional cost.

E. The Contractors' assistants shall include a competent electrical supervisor, who shall be on the premises at all times to check, layout, coordinate and superintend the installation of work. The supervisor shall establish basic requirements relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers' and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of Shop Drawings and Product Data for every item of equipment. Shop drawings or product data will not be considered until Manufacturers' Lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor's name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.
3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.
4. Exclusively electrical items furnished as items associated with mechanical items but not specifically described in the mechanical item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the mechanical item by identified specification paragraph.

5. Product data sheets shall be 8.5-inches by 11-inches cut sheets for operating and maintenance manual.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of owner's representative, and project type and size.

E. After the work is completed, submit required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the COTR prior to final acceptance of the work.

1.10 SPECIALIST

A. The term "Specialist" as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer's direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:

a. Contract Drawings.
b. Specifications.
c. Addenda.
d. Change Orders and other Modifications to the Contract.
e. Reviewed shop drawings, product data, and samples.

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:

    a. Manufacturer's name and product model and number.
    b. Product options, substitutions, or alternates utilized.
    c. Changes made by addenda and modifications.

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:

    a. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
    b. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
    c. Field changes of dimension and detail.
    d. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.
2. Prepare covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," and title of project.
3. Internally subdivide the contents with permanent page dividers, logically organized as described below
4. Contents: Prepare a Table of Contents, with each product or system description identified.
5. Part 1: Directory, listing names, addresses, and telephone numbers of electrical engineers; contractor; electrical subcontractors; and major electrical equipment suppliers.
6. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

    a. Significant design criteria.
    b. List of equipment.

c. Parts list for each component, including recommended spare parts list.
d. Operating instructions.
e. Maintenance instructions for equipment and systems.
f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

7. Part 3: Project documents and certificates, including the following:

a. Shop drawings and product data.
b. Photocopies of certificates.
c. Photocopies of warranties, guarantees, and bonds.
d. Test reports: Copies of the results of tests required under sections of specifications.
e. Photocopies of each panelboard circuit directory or directories for each panelboard provided, including panel name, panel location, panel ratings, spare circuit breakers and spaces for additional circuit breakers.

8. Submit one copy in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.
9. Submit final revised copy within ten days after final inspection.
10. Submit operation and maintenance data in electronic format using USB flash drive storage media.

1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The electrical, building, fire, and safety codes of the Smithsonian Institution.
2. The National Electric Code, NFPA 70 (NEC).
3. The National Fire Protection Association Code (NFPA).
4. International Building Code (IBC).

5. International Energy Conservation, Fire, and Electrical Codes (ICC).

1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply.

1. Factory Mutual (FM)
2. Federal Specifications (FS)
3. Military Standards (Mil. Std.)
4. American National Standards Institute (ANSI)
5. American Society for Testing and Materials (ASTM)
6. International Code Council (ICC)
7. Institute of Electrical and Electronics Engineers (IEEE)
8. National Electrical Code (NEC) (NFPA 70)
9. National Electrical Manufacturer's Association (NEMA)
10. National Fire Protection Association (NFPA)
11. The Occupational Safety and Health Act (OSHA)
12. Underwriters Laboratory Inc. (UL)
13. American Association of State Highway and Transportation Officials (AASHTO)
14. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
15. Illuminating Engineering Society of North America (IESNA)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for contents within these areas. Provide security measures necessary for this area.

B. Area shall be maintained and shall be returned to original condition at the completion of the project.

C. Store electrical construction materials such as wire, raceways and boxes, devices, and equipment in buildings, enclosed trailers, or portable enclosed warehouses.

1. Materials and products subject to damage from moisture: Store in dry locations. If necessary, protect with protective wraps or covers.
2. Plastics and other materials and products subject to damage from heat or cold: Store at manufacturer's recommended temperatures.

3. Plastics and other materials and products subject to damage from sunlight: Protect from sunlight.

D. Electrical equipment such as motor controllers, panelboards and circuit breakers stored before installation and installed during construction: Provide clean, dry locations at manufacturer's recommended temperatures, and cover or wrap if required to protect from incidental damage.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.
5. Protect areas occupied by Owner's personnel or equipment.
6. Seal off return air registers and other mechanical systems to prevent dust from entering.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair damage or soiling to the complete satisfaction of the COTR; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, at no addition to the Contract sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer's recommended temperatures.

E. Protect electrical materials and products from weather events and accidents of construction.

F. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.16 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.17 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in "Cutting and Patching" below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the COTR in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.18 WARRANTY

A. Work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties as specified in individual sections.

B. During the correction period, the Contractor shall begin correcting any work found to be not in accordance with the requirements of the Contract Documents within 4-hours of receiving written notice from the Owner. Provide detailed schedule for completion of work within 24-hours of receiving written notice from the Owner and revise schedule based on any Owner comments generated. Except as otherwise required in General Conditions and Division 01, the correction period is one year after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

   1. Service reports for warranty work shall be provided to the Owner.

C. When use of the permanent equipment has been permitted for temporary services during construction of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers' standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.19 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor's and subcontractors' responsibilities are described in Divisions 01 and 23.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Where new equipment must pass through existing openings (e.g. doors), measure width of opening and width of equipment. If equipment is wider than opening, perform whatever measures are necessary to widen opening (e.g. removal of door frames), then restore opening to its original condition.

C. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of raceways. Close superfluous openings and remove debris caused by work of this division.

D. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the COTR.

E. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and materials used for any patching or mending shall conform to the class of materials originally installed.

F. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

B. Temporary feeders from the existing switchboard may use any wiring technique that complies with the National Electrical Code. Note that NEC Article 590, **Temporary Installations**, does not apply to the temporary feeders as they shall be in use for more than ninety days.

3.3 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or COTR finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, COTR shall be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

3.4 COMMISSIONING

A. Comply with requirements of ‘Commissioning” in Part 1 above.

END OF SECTION 260101

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to work of more than one section of Division 26.

B. Basic materials and equipment required for electrical work.

C. Date sensitive equipment.

D. Operating instructions.

E. Testing wiring systems.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 260101.

B. Operation and Maintenance Manuals: Division 01 and Section 260101.

C. Painting: Division 09.

D. Commissioning requirements: Division 01 and Division 23.

1.3 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

1.4 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed on the basis of using the particular manufacturers' products specified and scheduled on the drawings.
B. Products of other manufacturers that are listed under the article "Acceptable Manufacturers," or permitted as "equal," are permitted provided:

1. Product shall meet the specifications.
2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that make their use impractical or cause functional fit, access, or connection problems.

1.5 SUBMITTALS

A. Test reports: Show that tests specified in Part 3 below demonstrate the specified results.

1.6 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the electrical, building, fire, and safety codes and regulations of the Smithsonian Institution.

B. Electrical control panels, equipment, materials and devices provided or installed as work of Division 26 shall bear UL label, or, if UL label is not available, the item shall be tested and labeled by a qualified testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70. Provide testing, if required, without addition to the contract sum.

C. VOC content: Field-applied adhesives and sealants, limits per South Coast Air Quality Management District (SCAQMD), Rule No. 1168.

D. Products shall contain no urea-formaldehyde content.

1.7 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractors' and subcontractors' responsibilities are described in Division 01 and Division 23.

PART 2 - PRODUCTS

2.1 GENERAL

A. Techniques, testing, and operating instructions specified in this section apply to products specified in other sections of Division 26.

B. Equipment that uses or processes date and time data in order to perform its function shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

2.2 MATERIALS

A. Electrical equipment backing panels, indoors: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated in accordance with AWPA C27, in thickness indicated, not less than 13 mm (0.5 inch) nominal.

1. One side finished.

B. Electrical equipment backing panels, outdoors: Plywood, DOC PS 1, Exterior, HDO (High Density Overlay) B-C, pressure -treated in accordance with AWPA U1 with preservatives as required for above ground exposure, suitable for Use Category UC3B.

C. Wood-preservative-treated lumber: Treated by pressure process, AWPA C2, with chemicals acceptable to authorities having jurisdiction, and marked with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. Application: Treat items indicated on the drawings, and the following:

a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.
b. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
c. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
d. Wood framing members that are less than 460 mm (18 inches) above the ground in crawlspaces or unexcavated areas.
e. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DATE-SENSITIVE EQUIPMENT

A. Date-sensitive equipment: Systems, equipment, or components which use or process date and time data in order to perform their functions.

B. Each item of date-sensitive equipment used in the project shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

PART 3 - EXECUTION

3.1 GENERAL

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify COTR if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

B. The contract drawings are diagrammatic, and do not indicate all fittings or offsets in raceway or all pull boxes, access panels, or other specialties required. Provide required fittings, offsets, access panels, and specialties to coordinate the work.

C. Mounting heights for devices are to the center of the device unless otherwise indicated.

D. Comply with the Americans With Disabilities Act for maximum mounting heights.

E. Mounting heights for luminaires are to the bottom of the luminaire.

F. No raceway shall be run below the head of a window or door. No raceway shall be run directly below a skylight.

G. Equipment and raceways installed in areas without a suspended ceiling shall be as tight to structure as possible, but at least above a height of 2032 mm (6'-8"), unless otherwise noted.

H. Items which require access for operation or maintenance shall be easily accessible. Do not cut or form hand holes for operation or maintenance of appliances through walls or ceilings.

3.2 INSTALLATION OF PRODUCTS AND EQUIPMENT

A. Install raceway exposed to view parallel with the lines of the building and as close to walls, columns, and ceilings as may be practical, maintaining adequate clearance for access at parts requiring servicing.

B. Install raceway a sufficient distance from other work to permit a clearance of not less than 13 mm (0.5 inch) between its finished covering and adjacent work.

C. Pull boxes and other appurtenances which require operation or maintenance shall be easily accessible. Do not cut or form handholes for operation or maintenance of appliances through walls or ceilings.

D. Install plywood backing panels with finished face exposed.

3.3 OPERATING INSTRUCTIONS (DEMONSTRATION)

A. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of systems and equipment.

1. Instructions by manufacturer's technical representative for each type of equipment shall include the performance of the recommended preventive maintenance procedures for that equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions for use by instructors and Owner personnel.

E. Schedule the general and specialized instruction periods for a time agreed upon by the COTR.

3.4 TESTS

A. During the progress of the work and after completion, test the branch circuits and distribution system, and the low-voltage alarm and signal systems.

B. Results of the tests shall show that the wiring meets the requirements of this specification. Should any test indicate defect in materials or installation, immediately repair, or replace with new, the faulty installation, and retest the affected portions of the work.

C. Furnish equipment and instruments necessary for testing.

D. Tests shall demonstrate the following:

1. Lighting, power, and control circuits are continuous and free from short circuits.
2. Circuits are free from unspecified grounds.
3. The resistance to ground of each non-grounded circuit is not less than one megohm.
4. Circuits are properly connected in accordance with the applicable wiring diagrams.
5. Circuits are operable. Demonstration shall include functioning of each control not less than ten times, and continuous operation of each lighting and power circuit for not less than 0.5 hour.

E. Test circuit breakers larger than 100 amperes at full voltage.

F. Make voltage built-up tests with a voltage sufficient to determine that no short circuits exist.

G. Immediately repair defects and retest until systems are operating correctly.

H. Submit test reports.

END OF SECTION 260500

SECTION 260501 - EXCAVATION AND FILL FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Trenching, backfilling, and compacting for electrical work underground inside the building and extending 1.5 meters (five feet) beyond exterior building walls, and outside the building as shown on drawings.

B. Restoring and reseeding grassed areas.

1.2 RELATED SECTIONS

A. Cutting and patching: Division 01 and Section 260101.

B. Repairing pavements: Division 32.

C. Underground electrical ductbanks: Section 260544.

D. Conduit: Section 260533.

E. Identification for electrical systems: Section 260553.

1.3 REFERENCES

A. ASTM D 1557: Laboratory Compaction Characteristics of Soil Using Modified Effort (2700 kN-m/cu m) (56,000 ft-lbs/cu ft).

1.4 SUBMITTALS

A. Shop drawings: At the same scale as the contract drawings, showing field verified locations of utilities and underground irrigation system, and proposed detailed trenching plan.

B. Product data: Seed and mulch.

C. Certifications: Test reports showing that compaction meets specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill: Earth materials, free from perceptible amounts of wood, debris, or topsoil, free of frost at the time of placement, and not containing marl or other elements which tend to stay in a plastic state.

B. Grass seed: Match the mix the Zoo purchases from Newsom Seed Warehouse (11788 Scaggsville Road, Fulton, Maryland 20759. 800-553-2719). Seed shall be endophyte-free.

C. Mulch: Free of sticks, weeds, or other foreign matter; either double-shredded or triple-shredded red oak; fibrous by-product of extraction. Use only one type throughout the project.

2.2 EQUIPMENT

A. Mechanical tampers for compacting backfill: Capable of exerting a blow equal to 12 kPa (250 pounds per square foot) of area of the tamping face.

PART 3 - EXECUTION

3.1 PREPARATION

A. The general locations of underground utilities are indicated on the drawings and are not to be assumed to be accurate or complete. Before beginning work, field check the area with the most accurate instruments available, such as Fisher Labs' Pipe and Cable Locators.

3.2 INSTALLATION

A. Perform all excavating, cutting of paved areas, trenching, sheeting, shoring, backfilling, and compacting required for the proper installation of the work. Repair of pavement is specified in Division 32.

B. Where obstructions are encountered, obtain written approval and make necessary changes in line, grade or location.

C. Protect existing utilities from damage during excavation and backfilling. Repair damaged new or existing work at no addition to the contract sum. Bracing, shoring and other protection of existing utilities is part of this work.

D. Do not damage or remove existing shrubs or trees including their root systems, without prior notification to the COTR.

E. Provide temporary roadways over trenches with railings and other safeguards, including amber blinker lamps or other warnings for night use.

F. Note the depths of footings. In cases where conduit is in close proximity to or below footings and where the natural earth under footings is disturbed, after the line is installed, the voids shall be filled up to bottoms of such footings with solid concrete.

3.3 CUTTING

A. Cut concrete and asphalt concrete with masonry saw prior to breaking it into smaller pieces for removal.

B. Cut sidewalks perpendicular to the length at the closest existing joint that is a minimum of 24 inches back from either side of the top of the new trench.

3.4 TRENCHING

A. Excavations inside the building shall be carefully planned. Stockpile excavated earth so as not to interfere with other construction. Dig trenches to the proper depths, providing extra depressions where required for hubs of pipes.

B. Excavations outside the building shall generally follow the routes indicated on the drawings. Stockpile topsoil separately for later replacement. Excavations shall be of sufficient depths to provide, unless indicated otherwise on the drawings, a minimum cover as follows:

1. Electrical conduit: Depth required by NFPA 70 (NEC).

C. Trenches shall be of necessary depth and width for the proper laying of conduit with a minimum of 205 mm (8 inches) on each side of the joint.

1. The sides shall be as nearly vertical as practicable. Unless local regulations are more strict, trenches 1220 mm (4 ft.) and deeper shall have shored sides as required by OSHA trenching regulations.
2. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for each section of conduit on undisturbed soil at every point along its entire length, except for bell holes.
3. No greater length of trench shall be left open, in advance of the completed structure placed in it, than can be completed in that day’s operation.

4. Except where rock is encountered, do not excavate below the depths required. Where rock excavation is required, excavate to a depth of at least 150 mm (6 inches) below the trench depth and fill the overdepth with compacted crusher run or bank run stone or sand. Unauthorized overdepths in excavation shall be backfilled with crushed stone, slag or gravel, thoroughly compacted.
5. Whenever wet or otherwise unstable soil is encountered, it shall be removed to the depth and extent directed, and the trench backfilled to the proper grade with crushed stone, slag or gravel.

D. Should springs be encountered within the work area, or soft soil conditions at the elevations required for load bearing, immediately notify the COTR and do not place any portion of the work on such surfaces until instructions are received.

E. Furnish and maintain pumps, flumes, gutters, and appurtenances if required to keep the excavations free from water. Water shall be directed to a point remote from building operations, shown on the approved shop drawing.

F. Excavation for manholes and similar structures shall be sufficient to leave a minimum of (305 mm (12 inches) and a maximum of 610 mm (24 inches) clearance on all sides. Fill over-depth excavation with concrete.

3.5 BACKFILL

A. Place no backfill until the adjacent construction or the utility to be covered has been inspected, tested, and approved.

B. Installing underground warning tape: Install in backfill above exterior buried lines not encased in concrete. Select legend and color appropriate for type of line. Install metallic lined tape for non-metallic lines. Install approximately 305 mm (12 inches) below grade.

C. Electrical systems backfill:

1. Backfill and compact in 200-mm (8-inch) layers, to level finished grade with the excavated materials approved for backfilling.
2. Surplus earth shall be mounded up on excavation and left to settle. When directed by the COTR, surplus earth shall be removed and excavations leveled off to proper grade. Where direct burial cables are placed in trenches, first cover the cables with clean earth.

D. Structure backfill:

1. Do not backfill against structures with cement mortar joints until the mortar is at least twelve hours old.

3.6 COMPACTION

A. Test in accordance with the requirements of ASTM D 1557.

B. Compact under slabs, roads, and sidewalks to a 95 percent density.

C. Compact unpaved areas to a 90 percent density.

D. Backfill and compact trench in unpaved areas to within 102 mm (4 inches) of existing grade. Furnish and install compacted select topsoil for the final layer to finish even with existing grade. Remove surplus earth and rake unpaved areas for final planting.

E. Take particular care in compaction of earth under joints of mechanical piping.

3.7 SEEDING

A. Seed disturbed grass areas at the rate of 1.82 kg (4 pounds) per 92.9 sq. m (1000 sq. ft.), with the seed mix specified. Mix seed thoroughly into the top 25.4 mm (one inch) of soil.

B. Uniformly distribute seed with an approved machine to ensure a covering of plus or minus 6 mm (1/4 inch). Sow half of the seed in one direction and the rest at right angles.

C. Do not seed during windy weather or when ground is wet or otherwise untillable. Seed between the dates of April 1st to June 15th or September 15th to November 15th unless otherwise approved in writing.

3.8 MULCHING

A. Mulch seeded areas immediately following seeding with fibrous mulch evenly applied at an average rate of 4483 kg per hectare (2 tons per acre) so as to provide a loose depth of not less than 50 mm (2 inches).

B. Wet down mulch, unless a heavy rain wets it, to the COTR’s satisfaction, immediately after application.

C. Watering shall be the responsibility of the Contractor until the project is turned over to the Smithsonian.

3.9 RESURFACING

A. Resurface sidewalks, roads, streets, and other paved areas as work of this section, matching the construction and finish of adjacent paving. Paving shall meet the requirements of Division 32.

END OF SECTION 260501

SECTION 260504 - ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Extent and location of demolition are shown on the drawings.

B. Removal and disposal of PCB-containing fluorescent light ballasts.

C. Removal of fluorescent lamps without breaking them, and disposal to a recycler.

D. Removal and disposal of batteries.

1.2 RELATED SECTIONS

A. Demolition: Division 02.

B. Asbestos Removal: Division 02.

1.3 SUBMITTALS

A. Shop drawings: Demolition and removal procedures and schedules.

1. PCB disposal plan.

B. Certifications showing compliance with EPA and District of Columbia regulations for removal and disposal of PCB-containing lamp ballasts, including but not limited to:

1. Contractor’s generator identification number.
2. Hazardous waste manifests.
3. Certification of licensed hazardous waste hauler.
4. Certification of disposal facility.

C. Certifications showing compliance with EPA and District of Columbia regulations for the removal and disposal of lead-acid, nickel-cadmium, nickel metal hydride, and lithium batteries (e.g. from emergency battery units), including but not limited to:

1. Hazardous waste manifests.
2. Certification of recycling facility or disposal facility.

D. Qualifications of fluorescent lamp recycler as required in the article "Quality Assurance" below.

E. Project record documents:

1. Record drawings.
2. For PCB removal, copies of completed required forms showing compliance with EPA requirements. Forms include, but are not limited to, records showing that the correctly identified hazardous material from this project has been properly transported, delivered, and accepted at the certified disposal facility.
3. For fluorescent lamp disposal, records demonstrating that all the fluorescent lamps removed from the site have been received and accepted at the recycling facility. Receipt or bill of sale shall include the typewritten name and signature of the person responsible for receiving and logging in, and shall be dated.

1.4 QUALITY ASSURANCE

A. Demolition shall be carried out as expeditiously as possible, in accordance with accepted practice and applicable building code provisions.

B. For PCB removal:

1. Regulatory requirements: Comply with EPA requirements for removal, handling, and disposal of PCB-containing lamp ballasts.
2. Instruct employees on the dangers of PCB exposure; protective clothing; methods for identification, removal, and storage on site; and applicable EPA regulations.
3. Dispose of PCB-containing ballasts and PCB-contaminated materials by incineration at an EPA-approved rotary kiln incinerator.

C. Fluorescent lamp recycler shall be in compliance with federal and state regulations applicable at its location, including licenses if required, to commercially recycle lamps and mercury-containing materials.

1.5 HANDLING AND STORAGE

A. PCB-containing ballasts:

1. Store removed ballasts in lined steel drums or other approved leak-proof containers, labeled in accordance with EPA requirements, in a secured area.
2. Containers shall be removed from the site within 30 days.

B. Fluorescent lamps:

1. Handle lamps so as not to break them. Store and ship in containers which prevent breakage during storage and shipping.
2. Store lamps in secure location approved by the COTR, until they are shipped to the recycler.
3. The lamps are not defined as hazardous. If a few lamps should be broken accidentally, treat the debris as general construction debris.

1.6 PROJECT CONDITIONS

A. If, in the course of the work, workers unexpectedly encounter a material not identified for special removal but which they suspect to be asbestos, to contain lead or PCBs, or to present some other hazard:

1. Promptly notify the COTR in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

B. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.

C. Locate, identify, and protect mechanical and electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 PREPARATION

A. In areas where lamp ballasts are to be removed, protect floors and other surfaces with plastic sheeting.

B. Coordinate removal and storage of fluorescent lamps and ballasts. Protect lamps to prevent breaking them during removal.

C. Protect existing building and equipment that is to remain, particularly to prevent entry of either dust or water. Ensure weathertightness at all times. Keep materials on hand to patch and maintain protection.

3.2 DEMOLITION

A. Comply with demolition and disposal requirements of Division 02.

B. Perform removal work neatly with the least possible disturbance to the building.

C. Provide temporary barriers, danger signals, and appurtenances for protection of personnel and equipment during removal operations.

D. Demolish, remove, demount, and disconnect inactive and obsolete raceway, fittings and specialties, equipment, and luminaires.

1. Raceway and ducts embedded in floors, walls, and ceilings may be abandoned in place if they do not interfere with new installations. Cut back to at least 25 mm (one inch) below finished surface.
2. Remove materials above accessible ceilings.
3. Disconnect and cap items to remain behind finished surfaces.
4. If existing raceways, outlet boxes, and junction boxes are shown to be removed, but could be reused for new work, Contractor may submit a request in writing to the COTR to reuse the existing materials rather than remove them. The request shall include drawings indicating the exact raceways, outlet boxes, and junction boxes to be reused.
5. Patch and repair surface materials as required in Division 01 and Section 260101 article, “Cutting and Patching.”

E. Remove the anchors, bolts, and fasteners associated with raceway and equipment to be removed.

3.3 REMOVAL OF FLUORESCENT LAMP BALLASTS

A. Where fluorescent luminaires are shown on the drawings to be removed, remove ballasts.

B. If a ballast is stenciled “No PCBs”, dispose of it as general demolition debris. If ballast has no such identification, assume that it contains PCBs.

C. Workers removing ballasts shall be: informed as to the danger of skin contact with PCBs; informed that PCB-containing ballasts contain paper or cardboard impregnated with PCBs inside the casings; instructed to handle ballasts so as not to damage the casings; and shall wear protective gloves.

D. Examine ballasts for evidence of leaking PCBs. Black, tarry material may contain PCBs. Where leakage has contaminated materials outside the ballast itself, dispose of the contaminated materials by the same methods used to dispose of the ballasts, except that nonporous surfaces such as smooth metal or plastics may be properly decontaminated and then treated as clean material.

3.4 REMOVAL OF FLUORESCENT LAMPS

A. Remove lamps without breaking them and pack in protective containers for shipment to recycler.

B. Prepare a record of lamps removed and prepared for shipment. This record shall be used to account for disposal of lamps to qualified recycler.

3.5 DISPOSAL

A. Dispose of equipment and materials removed, and rubbish and waste material, as work progresses. Do not allow demolition debris to accumulate on site. Remove products of demolition from the building daily.

B. Transport and dispose of PCB-containing ballasts, discarded protective clothing, and other contaminated material in accordance with applicable EPA regulations. Maintain and submit records showing compliance with regulations, as specified in Part 1 above.

C. Transport fluorescent lamps without breaking them and deliver to the recycler. Submit records of disposal as required in Part 1 above.

END OF SECTION 260504

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SECTION 260519 - WIRES AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wire and cable rated 600-volts and less.

B. Type MC, Type AC-HCF, and Type NM cables are not permitted.

1.2 RELATED SECTIONS

A. Underground ducts and utility structures: Section 260544.

B. Raceways: Section 260533.

C. Lighting controls: Section 260923.

D. Lighting: Section 265100.

E. Voice and data communication cables: Section 271500.

1.3 REFERENCES

A. ANSI/NEMA WC 70 – Power Cables rated 2000 Volts or Less for Distribution of Electrical Energy.

B. ASTM B3 – Standard Specification for Soft or Annealed Copper Wire.

C. ASTM B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors.

D. UL 44 – Standard for Thermoset-Insulated Wires and Cables.

E. UL 83 – Standard for Thermoplastic-Insulated Wires and Cables.

F. Additional UL Standards as indicated.

1.4 SUBMITTALS

A. Product data:

1. Each type of wire and cable, including accessories.

2. Include copies of UL certifications showing compliance with requirements in "Quality Assurance" below.

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. Products and installation shall comply with NFPA 70 and other applicable national, state, and local electrical codes.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General requirements: Deliver, store, and handle wire and cable in accordance with the manufacturer's instructions.

1. Wire and cable shall be packaged in a manner that protects them during ordinary handling and shipping. Ship from manufacturer with ends temporarily sealed against moisture.
2. Protect wire and cable during storage (both onsite and offsite).

    a. Store in a clean and dry location. Elevate from surfaces where water can accumulate, and cover cable rolls to protect against weather.

3. Handle wire and cable as recommended by the manufacturer. Do not pull from the center or periphery of the cable reel.
4. Damaged wire and cable shall be removed from the project site.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE (600-Volts Max.)

A. Conductors: UL listed and NEMA WC 70 compliant; Copper, 98 percent conductivity, suitable for 600-volt duty; rated 90-degree Celsius temperature for wet/dry applications; solid bare annealed copper for No. 10 and smaller complying with ASTM B 3, and stranded for No. 8 and larger complying with ASTM B 8.

B. Conductor insulation:

1. Type THHN/THWN-2: Comply with UL 83; PVC insulation, nylon jacket.
2. Type RHH / RHW-2: Comply with UL 44; stranded conductors, XLPE insulation.

C. Conductor identification: Markings along outer braid denoting conductor size, voltage classification, type of insulation, and manufacturer's trade name, and color code. Identification shall extend to branch circuits and outlets. Use the color coding system tabulated below throughout the building's network of feeders and circuits, unless otherwise required by the authority having jurisdiction.

1. Colors on conductors No. 10 and smaller, or No. 6 and smaller for grounded and grounding conductors: Solid colored insulation.
2. Colors on conductors No. 8 and larger, or No. 4 and larger grounded and grounding conductors: Colored tape wrapped a minimum of 6 inches (150 mm) on either end of conductor.

COLOR CODE (600 V Max.)				
VOLTAGE	NEUTRAL	PHASE		
		A	B	C
120-V, 2-wire	White	Black, Red, or Blue depending on phase		
208/120-V wye, 3-phase, 4-wire	White	Black	Red	Blue

D. Wires used solely for grounding purposes shall be green, where insulated.

E. Control wiring shall be coded with colors different from those used to designate phase wires.

2.2 WIRING ACCESSORIES

A. Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service where installed.

B. Twist-on wire connectors (dry locations):

1. Color-keyed.
2. Basis of design: Ideal Industries, Inc., Wingnut®, 3M Company "Scotchlok", or King Innovation.

C. Twist-on wire connectors (damp and wet locations):

1. Connectors shall be listed under UL 486D.
2. Basis of design: Ideal Industries, Inc., UnderGround®, models 60, 64, or 66 as appropriate; King Innovation DryConn®; or 3M Company.

D. Compression connectors:

1. Color-keyed.
2. Basis of design: 3M Company "Scotchlok"™ compressor connectors, "10000" series for copper conductors, "20000" series for aluminum conductors, or Thomas & Betts (Blackburn) or Ilsco.

E. Compression connectors (damp and wet locations):

1. Protect the connectors with a waterproof system, UL-listed for direct burial and 600 volts.
2. Basis of design: 3M Company 8420 series, Thomas & Betts Model DBSK82, or IIsco.

F. Compression taps:

1. Series CT-2 tap with CT-2C cover, or Series 54710 color-keyed compression taps,
2. Basis of design: Burndy Corporation "Versitap" or OZ/Gedney.

G. Power distribution blocks:

1. Basis of design: Hubbell Burndy “U-Blok.”

H. Multi-tap connectors, clear insulated:

1. Basis of design: Burndy Corporation "UNITAP" or Ilsco "Cleartap".

I. Terminal strips for #8 conductors and smaller: Plastic housing with UL-94V2 flammability, 20 ampere, 300 volt, (or amperage and voltage ratings as appropriate), number of terminal pairs as indicated on drawings: Ideal 89-600 series or equal by Molex.

2.3 UNDERGROUND CONDUCTORS

A. Underground cable, Type RHH/RHW-2: Single-conductor, underground cable.

1. Cable: UL 44 listed; NEMA WC 70 construction; 600-volt, single-conductor. Solid copper No. 10 and smaller, stranded copper No. 8 and larger; and with XLPE insulation.

2.4 PLENUM CABLES

A. Plenum cable:

1. Insulated with material that is UL classified for low flame and smoke-spread characteristics, for use in plenum areas without raceway in accordance with the requirements of NFPA 70.
2. Communications cable: Type MPP or CMP in accordance with NFPA 70.
3. Insulator basis of design: Dupont “Teflon FEP”.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide wire and cable indicated in accordance with national and Smithsonian Institution electrical codes.

B. Conceal wire and cable in new construction and in locations with finished walls, ceilings, and floors unless otherwise noted on drawings.

C. Wire and cable serving systems over 100 volts shall be installed in raceways, except where otherwise noted on drawings.

D. Wire and cable serving systems rated below 100 volts shall be installed in raceways, except where otherwise noted in individual specification sections. Refer to paragraph “INSTALLING CABLE RATED BELOW 100 VOLTS” below for additional information.

3.2 INSTALLING INTERIOR WIRING

A. Sizes: Minimum sizes shall be as follows, unless a larger size is indicated on the drawings.

1. 120-volt branch circuits:

    a. Homerun from first outlet to panel: No. 12 when run is 15 meters (50 feet) or less; No. 10 when run is between 15 meters (50 feet) and 30 meters (100 feet); No. 8 when run is more than 30 meters (100 feet).
    b. First outlet to other outlets: No. 12.

2. Exit light and emergency lighting circuits: Do not install in raceways, outlet boxes, or other locations with non-emergency wiring systems.
3. Other systems (over 100 volts): Minimum No. 12 unless specified or shown on drawings to be smaller.

B. Wiring methods and locations: Wires and cables shall be installed based on the following requirements, unless otherwise noted.

1. Feeders, entirely above ground: Type THHN/THWN-2, single conductors in raceways.
2. Feeders, partly underground: Type RHW-2, single conductors in raceway.
3. Branch circuits, entirely above ground:

    a. Unless otherwise indicated, utilize Type THHN/THWN-2, single conductors in raceway.

4. Branch circuits, partially underground: Type RWH-2, single conductors in raceway.
5. All other applications: Provide Type THHN/THWN-2, single conductors in raceway or wire and cable type as indicated.

C. Splicing shall be done in outlet boxes and junction boxes and not in raceway.

1. Conductors No. 8 and larger: Terminated, spliced and taped, wherever practical, with compression connectors or solderless connectors. Use tools recommended by the manufacturer.
2. Splices in conductors No. 10 and smaller, including luminaires: Made with wire connectors.
3. Taps in conductors No. 6 and larger: Made with compression taps or power distribution blocks.

D. Wiring in high ambient temperature areas shall be of types required by NFPA 70 including over boilers and breechings, in luminaire channels, and on rooftops.

E. Wires shall be neatly shaped in panels, wireways, boxes, and appurtenances.

3.3 COORDINATION WITH DEVICES AND EQUIPMENT

A. Where conductor size or parallel conductors shown on drawings connect to terminals on devices or equipment which is not sized for the connection:

1. Provide a junction box as near the equipment as possible, but no more than three meters (ten feet) away. Obtain approval of location before installing.
2. Provide conductor(s) sized to the ampacity of the equipment, from equipment to junction box.
3. In the junction box, splice the conductors from the equipment to the conductors of sizes, or parallel conductors, shown on the drawings.

3.4 INSTALLING EXTERIOR WIRING

A. Sizes: Minimum sizes shall be as follows, unless a larger size is indicated on the drawings.

1. Exterior lighting circuits: Copper, No. 10 minimum, with an extra No. 10 (minimum) copper ground conductor.

B. Wiring methods and locations: Wires and cables shall be installed based on the following requirements, unless otherwise noted.

1. Feeders and branch circuits, exposed: Type THHN/THWN-2, single conductors in raceway.
2. Feeders and branch circuits, underground: Type RHW-2, single conductors in raceway.

C. Splicing shall be done in outlet boxes and junction boxes and not in raceway. Treat these boxes as wet locations.

1. Conductors No. 8 and larger: Terminated, spliced and taped, wherever practical, with compression connectors. Use tools recommended by the manufacturer.
2. Splices in conductors No. 10 and smaller, including luminaires: Made with wire connectors.
3. Taps in conductors No. 6 and larger: Made with compression taps or power distribution blocks.

3.5 INSTALLING CABLE RATED BELOW 100-VOLTS

A. Install in raceway, unless otherwise indicated in individual specification sections.

B. Where individual specification sections allow cable to be installed either in raceway or on J-hooks, install as follows:

1. Wiring method:

a. Wiring in walls, in concrete floors, above inaccessible ceilings, where exposed in finished spaces, exposed on walls, and wherever it may not be accessible or may be subject to physical damage: Install cables in raceway.
b. Wiring exposed in ceilings of unfinished spaces: Install cables in raceway.
c. Wiring concealed above accessible suspended ceilings: Install cables on J-hooks.
d. Wiring in ceiling spaces of communications equipment rooms: Install cables on J-hooks.

e. Wiring within enclosures, consoles, cabinets, desks, and counters: 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/or distribution spools.

2. Conceal raceway and cables, except in unfinished spaces, in open ceiling spaces, and raceways on existing walls.
3. Cable not in raceways:

   a. Do not install in hangers used for pipes, electric power raceways, or ceiling hangers, nor support it in any way by attachments to pipes, raceways, or ceiling hangers.
   b. Install without damaging conductors, shield, or jacket. Cables shall not be in contact with pipes, ducts, or other potentially damaging items.
   c. Install away from potential EMI sources, including electrical power lines and equipment.
   d. Install parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.

4. Cable support with J-hooks:

   a. Install J-hooks at intervals not exceeding 1524 mm (60 inches).
   b. Secure cables on J-hooks with cable ties. Avoid cinching cables.
   c. Provide separate J-hooks for each low-voltage system.

5. Each cable run shall contain an ‘S’ loop or other means to accommodate expansion or contraction.
6. Where ceiling plenums are used for passage of air by heating and air conditioning system, install cable in raceway or use UL listed plenum cable.

C. For cable installed in raceway, comply with requirements for raceways and boxes specified in Section 260533, Conduits, and Section 260534, Boxes.

   1. Provide separate raceway systems for each low-voltage system.
   2. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

      a. Pull cables simultaneously if more than one is being installed in same raceway.
      b. Use pulling compound or lubricant, if necessary. Use compounds that will not damage conductor or insulation.
      c. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage cables or raceway.

D. Avoid installing near hot utilities, which might adversely affect system performance or result in damage to the cable. If cable must be placed close to such utilities, keep it separate and protect with insulation.

E. Cable bends shall have a radius not less than the value recommended by the cable manufacturer.

F. Tag cables connected to electronic equipment, to show function and the location of other end. Securely fasten labels to the cable.

END OF SECTION 260519

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SECTION 260521 - WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Power and control wiring for equipment.

1.2 RELATED SECTIONS

A. Equipment: Installed items requiring electricity, specified in other sections or shown on drawings.

B. Control systems wiring: Section 230902.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Raceways, wires and cables, devices, and accessories as specified in other sections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide power wiring from the motor starters to each motor and its manual controlling device. Interlock and control wiring related to the automatic temperature control system shall be provided under Section 230902, Control Systems Wiring.

1. Make flexible or liquid tight connections as specified in Section 260533, Raceways.

B. Except where provided with equipment, furnish and install manual pushbutton stations and pilot lights, with wiring. Where stations and pilot lights are grouped at central locations, mount them under a common faceplate.

C. Rough in and connect to equipment furnished under other sections and equipment furnished by Owner. Make connections as indicated on drawings with exact locations and details determined by approved shop drawings of the equipment.

1. Under equipment sections, equipment will be set in position and the electrical devices and components furnished loose. Assemble, install, and wire under this section.

2. Accomplish rough-in from walls with flush outlet boxes and from floors by means of raceway couplings finishing flush with finished floor.

D. Certain equipment, as indicated, will be furnished with control panels and auxiliary control components. Mount the panels, furnish and install source wiring and disconnects, and completely connect controls and motors.

E. Provide source wiring, connections, and disconnects for mechanical heating, ventilating, and air-conditioning (HVAC) equipment specified in Division 23. Provide electrical interlock wiring in the motor control centers as required by the HVAC equipment and the control sequences. Refer to sections of Division 23 for equipment and controls.

1. Provide weathertight enclosures for disconnects for outdoor equipment.
2. Mount starters where required, and provide proper size overload protection.

F. Roof exhaust fans will be equipped with factory-wired disconnects located adjacent to the motor under the ventilator hoods as specified in Section 233400, HVAC Fans. Exhaust fans shall be controlled by various means as indicated on drawings.

1. For fans shown to be manually controlled, furnish and install a manual motor starting switch with pilot light, located where indicated.
2. Where necessary for larger and three-phase motors, provide magnetic starters.
3. Where fans are provided with electrically operated dampers, provide wiring and relays for single-phase damper operators on three-phase motors.

G. Where a Division 23 section requires installation of equipment under supervision of equipment manufacturer’s representative, coordinate electrical installation to cooperate with representative’s requirements.

H. Provide power sources for Owner-furnished equipment.

I. Provide power and control wiring for emergency generator, controllers, remote control panels and remote alarm bell. Mount remote annunciator and silence switch where indicated. Provide plastic nameplates under bell and switch.

J. Provide wiring where required to time clocks provided as specified in automatic temperature controls sections.

END OF SECTION 260521

SECTION 260526 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding electrical systems and equipment.

B. Ground system test.

1.2 RELATED SECTIONS

A. Cast-in-Place Concrete: Section 033000.

B. Gas flexible pipe connector:

1. Natural-gas piping: Section 231123.

1.3 REFERENCES

A. ANSI/TIA/EIA J-STD-607-D

B. IEEE STD 142

C. NFPA 70

D. ASTM F467 and F468

E. UL 467

1.4 DEFINITIONS

A. Area served by a separately-derived system: The area within the building that contains any part of a circuit of the system.

B. IBT: Intersystem Bonding Termination Grounding Busbar.

C. TMGB: Telecommunications Main Grounding Busbar, Primary Bonding Busbar.

1.5 SUBMITTALS

A. Product data:

1. Ground rods and connections.

B. Certifications: System test.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Ground conductor, unless specifically noted otherwise, shall be copper, 98 percent conductivity, solid for No. 10 AWG and smaller and stranded for No. 8 AWG and larger.

1. Provide insulated ground wires. Do not use bare ground wires except where explicitly noted.

B. Grounding and bonding busbars: Predrilled rectangular bars of electro-tin-plated copper, 6.3 mm (0.25 inches) thick, 300 mm (12 inches) long, unless otherwise indicated on drawings, with 7.9 mm or 11.1 mm (0.3125 inch or 0.4375 inch) diameter holes horizontally spaced 25.4 to 28.6 mm (1 to 1.125 inches) apart.

1. Intersystem bonding termination grounding busbar (IBT) and telecommunications main grounding busbar (TMGB) shall be 101.6 mm (4 inches) wide, with four rows of holes. The telecommunications main grounding busbar shall comply with ANSI/TIA/EIE J-STD-607-D.
2. Stand-off insulators for busbars shall be flame-resistant fiberglass-reinforced thermoset polyester, UL recognized per UL Standard 891.

C. Ground rods:

1. Copper bonded steel, 19 mm (0.75 inches) diameter by 3048 mm (10 feet) long, one end pointed and the other end tinned,
2. Basis of design: nVent (Erico).

D. Mechanical type ground connectors:

1. Connectors:

a. IEEE 837 and UL 467 compliant, listed for use for specific types, sizes, and combinations of conductors and connected items.
b. Basis of design: FCI Burndy G Series.

2. Nuts, bolts, and washers: Silicon bronze alloy type B per ASTM F467 and F468.

E. Exothermic type ground connections:

1. Exothermic welding systems.
2. Basis of design: “Cadweld,” manufactured by nVent (Erico).

F. Lugs:

1. Lugs shall be two- or four-hole.
2. Basis of design: Burndy Hylug series.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide the complete grounding of raceway systems, electrical equipment, conductor and equipment enclosures, motors, transformers, and neutral conductors in accordance with applicable codes. Grounded phase and neutral conductors shall be continuously identified. Continuity of metal raceways shall be insured by double locknuts.

B. Furnish and install main grounds for feeders to detached structures (e.g., barns) to cold water main (when available) in accordance with NEC requirement. In addition to the cold-water ground, provide a grounding grid system as indicated or as required by NEC and applicable codes.

C. Busbars shall stand off the wall a minimum of 50.8 mm (2 inches). Mount 152.4 mm (6 inches) above finished floor unless otherwise indicated. Insulate the busbar from its supports.

1. Conductors connecting busbar to other busbars, and to the grounding electrode system shall be attached to busbar with exothermic welds.
2. Connect other conductors to busbar using lugs.
3. Provide one busbar in each barn and other building that houses four-legged animals. These busbars shall be 305 mm (twelve inches) below the ceiling if inside the barn, and shall be high enough to avoid interference from sliding doors if on the barn exterior. Bond the busbar to the equipment grounding conductor of each circuit supplying the structure. If a panelboard’s feeder’s equipment grounding conductor is bonded to the busbar it is not necessary to bond each branch circuit from that panel.

D. Install copper grounding jumpers of 3/0 copper cable around each main water valve in each building. Install copper grounding jumpers around raceway expansion fittings. Jumpers shall be of adequate current carrying capacity corresponding to size of raceway.

E. Bonding separately-derived systems:

1. Each metal water piping system, not used as the electrical system's grounding electrode, in the area served by the electrical system shall be bonded to the electrical system's neutral by a system bonding jumper.
2. If exposed structural metal is not used as the grounding electrode for the system, bond exposed structural metal in the area served by the electrical system to the system's neutral by a system bonding jumper.
3. If a metal water piping system in the area served by the electrical system is bonded to exposed structural metal by a NEC-compliant bonding jumper, then only one of the two (piping or structure metal) need to be bonded to the electrical system's neutral.

F. Bonding straps and jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of raceway.

1. Bonding to structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to equipment mounted on vibration isolation hangers and supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connections for outdoor locations; if a disconnect-type connection is required, use a bolted clamp secured with a minimum of two bolts and lock washers.

G. Ufer ground (concrete-encased grounding electrode): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 6 meters (20 feet) long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.2 EQUIPMENT GROUNDING AND BONDING

A. Provide insulated equipment grounding conductors with feeders and branch circuits.

B. 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.

C. Signal and communication equipment: In addition to grounding and bonding required by NFPA 70, provide grounding systems complying with requirements in TIA-607-D.

1. Telephone and data equipment may share a common grounding system.

a. Provide a Telecommunications Bonding Backbone conductor (TBB) from the IBT to the TMGB, located in the telecommunications entrance facility (Room D5 in the Cheetah Conservation Station).
b. Where an IGT is in a room with a panelboard providing circuits to the telephone or data equipment in the room, locate the busbar as close as is practical to the panelboard, and bond the panelboard's equipment ground or enclosure to the busbar with a No. 4 AWG conductor.

2. For other communication equipment, such as fire alarm, intercom, CATV, and security panels, when located in a room other than where an IBT or the TMGB are, provide a grounding busbar in the same room as the equipment. Bond the grounding busbar to either an IBT or the TMGB with a No. 4 AWG minimum conductor.

D. Gas piping:

1. Comply with NFPA 54.
2. Provide bonding jumpers for each length of corrugated stainless-steel tubing (CSST).

a. Jumpers shall be No. 6 AWG or the same size as the equipment grounding conductor serving the equipment served by the CSST, whichever is larger.
b. Install in accordance with CSST manufacturers' instructions and NFPA 54.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553, Identification for Electrical Systems, for instruction signs. The label or its text shall be green.

B. Install labels at the ends of telecommunications bonding conductors where exposed.

1. Label text: "If this connector or cable is loose or must be removed for any reason, please call the zoo telecommunications manager."

3.4 GROUNDING SYSTEM TEST

A. Ensure that grounding system is continuous.

B. Ensure that resistance to earth is not more than the values listed below:

1. Barns and other buildings to be occupied by animals: 5 ohms.
2. All other structures: 10 ohms.

C. Test each ground rod for resistance to earth before making connections to rod; tie grounding system together and test for resistance to earth.

D. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall.

E. Submit written results of each test including location of rods as well as resistance and soil conditions at time measurements were made.

END OF SECTION 260526

SECTION 260528 - EQUIPMENT FOUNDATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Outdoor equipment foundations.

1.2 RELATED SECTIONS

A. Poles for surveillance cameras: Section 282000.

1.3 SUBMITTALS

A. Product data: Concrete mix, grout, reinforcement, and accessories.

B. Certifications: Test report showing strength of concrete.

PART 2 - PRODUCTS

2.1 CONCRETE

A. Concrete:

1. Outdoor: 31.0 MPa (4,500 psi) compressive strength at 28 days.

2.2 GROUT

A. Non-shrink grout: Premixed, consisting of non-metallic aggregate, cement, water-reducing and plasticizing agents; capable of developing minimum compressive strength of 48.3 MPa (7,000 psi) in 28 days.

1. Five Star Products, Inc. “Five-Star Grout”
2. L&M Construction Chemicals, Inc. “Crystex”
3. Sonneborn “Sonogrout”

2.3 METAL REINFORCEMENT

A. Reinforcing bars: Deformed steel bars in accordance with ASTM A615, Grade 60, clean and free from loose rust, scale, or other coatings that will reduce bond.

B. Welded wire fabric reinforcing: ASTM A 185 No. 6 steel wire spot-welded at intersections and of size 152 mm by 152 mm (6 inch by 6 inch) mesh.

C. Metal accessories: Include spacers, chairs, bolsters, ties, and other devices necessary for properly placing, spacing, supporting and fastening reinforcement in place.

PART 3 - EXECUTION

3.1 INSTALLING OUTDOOR EQUIPMENT FOUNDATIONS

A. Provide equipment foundations of size and thickness indicated.

B. Place reinforcement accurately in position shown, securely fasten, and support to prevent displacement before or during pouring. Clean, bend, place, and splice reinforcement in accordance with approved shop drawings. Lap ends and sides of mesh reinforcement in slabs not less than one mesh.

1. Coverage of main reinforcing shall be as follows: Slabs, 19 mm (0.75 inch); concrete poured against earth, 75 mm (3 inches); other locations, 50 mm (2 inches).

C. Properly align, level, and grout equipment.

END OF SECTION 260528

SECTION 260533 - CONDUITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Raceways and accessories, aboveground and below ground where not in duct banks.

B. Where the words “conduit” or “conduits” are used without referring to a specific type of conduit (e.g., flexible metal conduit), the words include conduit and electrical metallic tubing.

1.2 RELATED SECTIONS

A. Trenching: Section 260501.

B. Firestopping: Division 07.

C. Boxes: Section 26 0534.

D. Exterior duct banks, manholes, and handholes: Section 260544.

E. Painting: Division 09.

1.3 DEFINITIONS

A. ARC: Aluminum Rigid Conduit

B. EMT: Electrical metallic tubing.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquid-tight flexible metal conduit.

F. RGS: Rigid galvanized steel.

1.4 SUBMITTALS

A. Product data:

1. Each type of raceway included in the work, and related fittings.
2. Sleeves and sleeve seals.
3. Accessory materials.
4. Hangers and fasteners.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

B. Steel conduit and tubing:

1. AFC Cable Systems, Inc. (FMC and LFMC)
2. Allied Tube & Conduit; a Tyco International Ltd-Co.
3. O-Z/Gedney, Unit of General Signal.
4. Wheatland Tube Co.

C. Steel raceway fittings:

1. Appleton Electric Co.
2. Cooper Crouse-Hinds.
3. Hubbell, Inc.; Killark Electric Manufacturing Co.
4. O-Z/Gedney; Unit of General Signal.
5. Spring City Electrical Manufacturing Co.
6. Thomas & Betts Corporation.
7. Wheatland Tube Co.

D. Nonmetallic conduit, tubing and fittings:

1. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. Arnco Corp.
3. Beck Manufacturing.
4. CANTEX Inc.
5. Certainteed Corp.; Pipe and Plastics Group.
6. Lamson & Sessions; Carlon Electrical Products.

E. Wireways and fittings:

1. Hoffman Engineering Co.
2. Lamson & Sessions, Carlon Electrical Products.
3. Schneider Electric; Square D products.

F. Raceway hangers and supports:

1. Thomas & Betts “Kindorf”.
2. Tyco Power-Strut.
3. Unistrut Diversified Products.

G. Fasteners:

1. Caddy Fasteners by Erico Products Inc.
2. ITW Ramset “Red Head”.
3. Wej-It Fastening Systems.

2.2 RACEWAY AND FITTINGS

A. Galvanized steel conduit: Hot-dip galvanized with threads galvanized after cutting, one of the following:

1. Rigid full weight, heavy-wall steel conduit (RGS) conforming to UL 6 and ANSI C80.1.
2. Intermediate steel conduit (IMC) conforming to UL 1242 and ANSI C80.6.

B. Steel conduit fittings: Cast malleable iron fittings with smooth finish and full threaded hubs. Include steel or malleable iron locknuts, bushings, and other fittings.

1. Insulating bushings:

a. Basis of design: Thomas & Betts Series 22.

2. Hub fittings with recessed sealing ring and nylon insulated throat:

a. Basis of design: Thomas & Betts Series 370.

3. Fittings for exposed locations: Conduit outlet bodies, cast iron or cast aluminum, zinc or cadmium plated.

C. Aluminum rigid conduit: rigid full weight, heavy-wall aluminum conduit (ARC) conforming to ANSCI C80.5 and UL 6A.

D. Aluminum conduit fittings: aluminum with smooth finish and full threaded hubs. Include aluminum locknuts, bushings, and other fittings.

1. Insulating bushings: Equal to Thomas & Betts Series 22.
2. Hub fittings with recessed sealing ring and nylon insulated throat equal to Thomas & Betts Series 370AL.
3. Fittings for exposed locations: Conduit outlet bodies, aluminum.

E. Electrical metallic tubing (EMT): Hot-dip galvanized or sherardized thin-wall steel raceway conforming to UL 797 and ANSI C80.3.

F. Connectors and couplings for EMT: Concrete- or rain-tight, compression or set screw type, made of zinc- or chromium-plated steel. Connectors shall have nylon insulating throats.

1. Compression connector:

a. Basis of design: Thomas & Betts No. 5223.

2. Compression coupling:

a. Basis of design: Thomas & Betts No. 5220.

3. Set screw connector:

a. Basis of design: Steel City No. TC722A.

4. Set screw coupling:

a. Basis of design: Steel City No. TK122A.

G. Flexible metal conduit (Type FMC): Made of sheet metal strip, interlocked construction, conforming to UL 1.

H. Liquidtight flexible metal conduit (Type LFMC) shall conform to UL 360.

I. ARC to LFMC couplings: Equivalent to O-Z/Gedney Type 4Q.

J. Connectors for flexible metal conduit:

1. Angle wedge with nylon insulated throat.
2. Basis of design: Thomas & Betts “Tite-Bite” connector Series 3110 and 3130.

K. Liquidtight type connectors:

1. UL 14814A. Fittings: With nylon insulated throat.
2. Basis of design: Thomas & Betts Series 5331.

L. Plastic conduit: Polyvinyl chloride (PVC) Schedule 40, rated for use with 90-degree conductors, for exposed, underground, and encased applications, complying with NEMA Specification TC-2 and UL 651.

M. Plastic conduit fittings, solvents and adhesives:

1. Fittings: Complying with NEMA TC 3 and UL 514.
2. Solvents and adhesives: As recommended by conduit manufacturer.

N. Wireways: Steel wireway with hinged cover, UL listed as wireways and auxiliary gutters.

1. Cover: Opening complete width and length of wireway.
2. Finish: Baked enamel.
3. Basis of design: Square D “Square-Duct.”

O. Fittings for wireways: Made with removable covers to permit installation of a complete system with access to wires throughout the system, UL listed with wireways. Connections: Threaded screws at every connector.

P. Weatherproof expansion fittings:

1. With bonding jumpers.
2. Basis of design: O-Z/Gedney Types AX and TX.

2.3 SLEEVES FOR RACEWAYS

A. Steel pipe sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

1. Sleeves for exterior walls: Anchor flange welded to perimeter.

B. Sleeves for rectangular openings: Galvanized sheet steel of length to suit application. Minimum thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm): 0.052 inch (1.3 mm).
2. For sleeve cross-section rectangle perimeter equal to or more than 50 inches (1270 mm) and 1 or more sides equal to or more than 16 inches (400 mm): 0.138 inch (3.5 mm).

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.

2.4 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annual space between sleeve and raceway.

1. Sealing elements: EPDM or NBR interlocking links shaped to fit surface of cable or raceway. Include type and number required for material and size of raceway or cable.
2. Pressure plates: Reinforced nylon polymer. Include two for each sealing element.
3. Connecting bolts and nuts: Stainless-steel of length required to secure plates to sealing elements. Include one for each sealing element.

2.5 ACCESSORY MATERIALS

A. Pull rope:

1. Polypropylene, minimum 0.1875 inch (5 mm) thick, tensile strength 800 pounds (3559 N), work load 130 pounds (578 N).

B. Caps and plugs:

1. Basis of design: Thomas & Betts Series 1470.

C. Lubricant:

1. UL approved.
2. Basis of design: Ideal Industries, Inc. “Yellow 77”.

D. Bituminous protective coating: Coal tar based, self-priming on steel, applied in a wet film thickness at least 22.0 mils (559 microns) per coat.

E. Rust inhibitive paint:

1. Alkyd based, white, black, or bronzetone; applied in a wet film thickness of at least 2.9 mils.
2. Basis of design: Benjamin Moore Super Spec HP D.T.M. Alkyd Low Lustre P23.

2.6 RACEWAY HANGERS

A. Adjustable hangers:

1. Basis of design: Kindorf C-711 lay-in hanger or C-710 Clevis hanger.

B. Trapeze hangers:

1. Constructed of channels with notched steel straps.
2. Steel strap basis of design: Kindorf C-105.

C. Channels:

1. Steel, 38 mm (1.5 inches) wide with 22-mm (7/8-inch) continuous slot, gauges and weights.
2. Basis of design: Kindorf B-900 series, “Galv-Krom” trivalent chromium finish.

D. Beam clamps:

1. Adjustable type for connecting hanger rod to steel beam.
2. Basis of design: Kindorf E-160 or U-569

E. Hangers for raceway 1.0 inch (27 mm) and smaller, through or below bar joists: “Hang-on” hangers attached to joists with Minerallac scissor clips or two-piece stud clips.

F. Finish: For hangers, assemblies, plate washers, rods, locknuts, channels, bolts, and appurtenances:

1. Zinc plated, in indoor conditioned areas.
2. Stainless steel where outdoors or in barns and similar areas.

2.7 FASTENERS

A. General: Select fasteners such that load applied does not exceed one-fourth of manufacturer’s load capacity in 24000 kPa (3500 psi) concrete.

B. Fasteners to concrete: Self-drilling type expansion anchors, or machine bolt drop-in anchors for drilled holes. Fasteners to concrete ceilings shall be vibration- and shock-resistant.

C. Fasteners to drywall or cavity wall: Toggle bolts, hollow-wall drive anchors, or nylon anchors as required.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide complete, separate and independent raceway system for each of the various wiring systems including, but not limited to, the following:

1. Lighting
2. Power
3. Exit Lighting*
4. Emergency Lighting System*
5. Fire Alarm System
6. Control Wiring
7. Voice and Data Systems
8. Security Systems

*These wiring systems may be installed in common raceways.

B. Wire raceway systems completely, except where otherwise indicated, as shown on drawings and as required for satisfactory operation of each system.

C. Where wireways are required or used to facilitate the installation, size them to accommodate conductors, in accordance with NFPA 70.

D. Types and locations of raceways are scheduled at the end of the section.

E. Do not install conductors or pull rope during installation of raceway.

F. Where raceway is connected to a cabinet, junction box, pull box, or auxiliary gutter, protect the conductors with an insulating bushing. Provide locknuts both inside and outside the enclosure. Where raceway is stubbed up to above ceilings for future wiring, close ends with bushings.

1. When raceway is to be connected to an outlet box that cannot accommodate the size of the raceway (e.g., 53 mm (2”) raceway to an FD box that can only accommodate raceways up to 27 mm (1”)), provide an appropriately-sized junction box within 305 mm (12”) of the outlet box. Box shall be same NEMA rating as outlet box. Connect the raceway to the junction box. Connect the junction box to the outlet box with the same type of raceway, but the largest size the outlet box can accommodate.

G. Bituminous protective coating:

1. Coat exposed threads on steel conduits in concrete slabs at couplings and fittings, after joints are made up.
2. Coat metallic raceways below grade not in concrete, and where emerging from below grade or slabs, four inches above and below grade or slab.

H. Rust-inhibitive paint:

1. Exposed threads of exterior conduit.
2. Unfinished metal components.

I. Make turns in raceway runs with manufactured elbows or using machines or tools designed to bend raceway. Turns shall be not less than the various radii permitted by NFPA 70.

J. Sizes:

1. Do not use raceway smaller than 21 mm (0.75 inch), except where otherwise explicitly indicated.
2. Feeder raceways shall be as large as indicated, or as required by NFPA 70 (whichever is larger). Do not install more than one feeder in a single raceway.
3. Raceway sizes shown on drawings are based on Type THHN/THWN-2 wire.

K. Make vertical runs plumb and horizontal runs level and parallel with building walls and partitions.

L. Ground raceways as required by NFPA 70.

M. Where raceways pass through building expansion joints, and wherever relative movement could occur between adjacent slabs, equip with weatherproof expansion fittings and bonding jumpers.

N. Where raceways through roof cannot be installed inside equipment or pipe curbs, flash them in accordance with the SMACNA Architectural Manual.

1. Coordinate flashing details and materials with manufacturer and installer of roofing system.

O. Run raceways concealed in new construction except where connecting to surface-mounted cabinets and equipment, and in electrical and mechanical equipment spaces. Install raceway above suspended ceilings and within walls and partitions.

P. Install conduits in slab on grade where indicated on the drawings and where connecting to floor boxes. Conduits installed in slab on grade shall be above the vapor barrier. Maximum conduit size shall be 35 mm (1.25 inch). Slab shall be depressed as required to maintain a minimum of 51 mm (2 inches of concrete above the conduit. Conduit shall be secured in position to prevent damage or movement during the concrete pour.

Q. From each flush-mounted lighting or power panelboard, provide at least four 21 mm (0.75 inch) empty raceways, to terminate in furred ceiling space above. On floors above ground floor, provide two additional 21 mm (0.75 inch) raceways terminating in furred ceiling space below. Cap these raceways.

R. Immediately after each run of raceway is completed, test it for clearance, smooth the joints, and close at each end with caps or plugs to prevent entrance of moisture or debris.

S. Raceway installed outdoors or at indoor locations exposed to continuous or intermittent moisture shall provide a liquidtight seal. Use steel or malleable iron hub fittings. Coat exposed threads with bituminous protective coating.

T. Where conduit is stubbed up through concrete slab, exterior walls, or bearing walls, provide galvanized steel conduit elbows.

U. Install insulated bushings on ends of raceway stubs and sleeves.

V. Provide stainless steel hangers and supports for outdoor installations and where noted on drawings

3.2 INSTALLING PULL BOXES, JUNCTION BOXES, OUTLET BOXES

A. Install as specified in Section 260534, Boxes.

B. Install pull or junction boxes in long runs of raceways or where necessary to reduce the number of bends in a run.

1. Select inconspicuous locations. Do not install until locations have been approved by the COTR.
2. Install boxes flush with wall or ceiling surfaces, with flat covers. Where removable ceiling units are used, locate boxes above ceilings.

C. Verify door swings with door frame installed before locating switch outlets. Locate switch outlets on opposite side of door from hinges.

3.3 INSTALLING FLEXIBLE CONDUIT

A. Installation shall comply with NFPA 70.

1. Minimum length: Two feet (610 mm).
2. Maximum length: Six feet (1830 mm).

B. Make immediate connections to transformers, recessed luminaires, speakers, and other equipment in suspended ceilings with flexible metal conduit. Include sufficient slack to permit removal of fixture or equipment.

C. Make immediate connections to motors with liquidtight flexible metal conduit. Include sufficient slack to reduce the effects of vibration.

D. In wet locations, install liquidtight type, in such a manner that liquid tends to run off the surface and not drain toward the fittings.

E. Where fittings are brought into an enclosure with a knockout, install a gasket assembly consisting of an O ring and retainer on the outside.

3.4 INSTALLING PULL ROPE AND CONDUCTORS

A. After raceways are installed, fish pull rope. After completion of the work of this project, pull rope shall remain in ducts identified as to be left empty. For each empty raceway, these ropes shall be of the same size, strength, and material as the ropes used to pull cables and conductors through similar raceways of the project. Leave 150 mm (six inches) at each end of the pull ropes, tied off to the raceways.

B. Do not use a pull rope that has a tensile strength of more than one of the conductors of a two-wire circuit, more than two of the conductors of a three-wire circuit, or more than three of the conductors of a four-wire circuit.

C. Do not pull conductors into the raceways until the system is entirely completed and wet building materials are dry.

D. Use only a lubricant approved for use with conductor materials and pull rope materials.

3.5 INSTALLING SLEEVES

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.

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. 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.

D. Cut sleeves to length for mounting flush with both surfaces of walls.

E. Extend sleeves installed in floors 50 mm (2 inches) above finished floor level.

F. Size pipe sleeves to provide 6.4 mm (0.25 inches) of annular clear space between sleeve and raceway unless sleeve seal is to be installed.

G. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

H. Interior penetrations of non-fire-rated walls and floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.

I. Fire-rated-assembly penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply Division 07.

J. Roof-penetration sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

K. Exterior-wall penetrations: Seal penetrations using 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.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 INSTALLING RACEWAY HANGERS

A. Single runs of overhead raceways 1.25-inch (35-mm) size and larger shall be supported by adjustable hangers, using 0.375-inch (10-mm) rods for raceways up to 2.0 inch (53-mm) size and 0.5-inch (13-mm) rods for raceways larger than 2.0 inches (53 mm).

B. Support groups of raceways run in parallel on trapeze hangers suspended from 0.5-inch (13-mm) hanger rods.

C. Space hangers not over 3 m (10 feet) apart. Support raceways within 3 feet of each outlet, junction or pull box.

D. Below bar joist construction, support hangers from a length of structural channel, welded to the top chords of at least two joists.

E. Where large numbers of raceways are grouped together, stagger individual hangers so as not to concentrate the load on a few joists.

F. Where hanger rods are attached to structural beams, use adjustable beam clamps.

G. Attach hanger rods to concrete with expansion bolts and anchors.

3.8 RACEWAY IN EXISTING BUILDING

A. Remove superfluous electrical equipment and cap outlets not being used, as specified in Section 260504, Electrical Demolition.

B. In existing areas that are being renovated it is the intent to show on the drawings what the finished areas will contain when completed. Except as specified otherwise, existing raceway, and outlet boxes may be reused where they meet specifications and code requirements. Replace existing products or materials which are not suitable for reuse as determined by the COTR.

C. Suitably cap superfluous concealed outlets, and remove unused wire. Remove superfluous raceways exposed in finished areas, and abandon superfluous raceways concealed in walls.

D. Install concealed raceway in existing building wherever possible above ceilings, in new walls, behind new cladding of existing exterior walls (where space permits), and in existing furred spaces. Install exposed raceway in secondary rooms, such as storage rooms.

E. Where existing raceway penetrates a fire-rated partition, and there is no firestopping, provide firestopping. Maintain indicated fire rating of walls, partitions, ceilings, and floors at existing raceway penetrations. Comply with Division 07.

3.9 INSTALLING UNDERGROUND CONDUIT, GENERAL

A. Depth:

1. Buried under building slabs: Top of conduit no less than 12 inches below the vapor barrier. Seal around conduits where they penetrate the vapor barrier.
2. Outside building: Top of conduit no less than 24 inches below finish grade.

B. Slope: At least 3 inches in 100 feet away from buildings and toward manholes or other drainage points.

C. Cleaning: At the completion of each run, in each conduit, first run a testing mandrel not less than 12 inches (305 mm) long with diameter 0.25 inch (6.35 mm) less than the inside diameter of the conduit; then draw through a stiff-bristled brush until particles are removed. Immediately install conduit plugs.

D. Except at conduit risers, make changes in direction of runs, either vertical or horizontal, by long sweep bends. Bend may be made up of one or more curved or straight sections or combinations. Use manufactured bends with a minimum radius of 36 inches.

E. Where underground nonmetallic conduit runs penetrate floor slabs, exterior walls, or bearing walls, use galvanized steel conduit elbows. Coat metallic elbows with bituminous protective coating.

3.10 INSTALLING UNDERGROUND CONDUIT WITHOUT CONCRETE ENCASEMENT

A. Run conduit in straight lines except as necessary.

B. Trenches: At least 80 mm (three inches) clearance on each side of the conduit.

C. Warning tape: Install in backfill approximately 300 mm (12 inches) below grade.

D. Under existing roads and paved areas not to be disturbed, jack rigid steel conduit into place.

3.11 SCHEDULE OF LOCATIONS

A. RGS with screw joint couplings:

1. Conduits in concrete slabs except where noted to be plastic.
2. First five feet of conduit extending outside building.
3. Under roads and paved areas where existing pavement is not to be disturbed, extending at least five feet beyond edges of pavement.
4. Elbows penetrating floor slabs or bearing walls.

B. ARC with screw joint couplings.

1. Exterior wiring.
2. Wiring to exterior equipment.
3. Wiring in any space that will be occupied by an animal (e.g. stalls and runways that will be occupied by kudus).
4. Elbows penetrating exterior walls above grade that are not load-bearing.

C. FMC and LFMC:

1. Where noted elsewhere in this section.
2. For purposes of this requirement, treat breezeways and the interiors of barns and stalls as wet locations.

D. EMT:

1. Sizes 102 mm (4 inches) and smaller except as noted above.
2. Use set-screw fittings for all systems except security. Security wiring when in EMT shall use compression fittings.

E. Plastic (polyvinyl chloride) with solvent cement joints:

1. For exterior circuits, directly buried, except first five feet from building.
2. Where noted under concrete slab, concrete encased, except elbows penetrating floor slabs, exterior walls, or bearing walls shall be rigid conduit.
3. Where noted under concrete slab, direct buried.
4. Where noted in concrete slabs.
5. For concrete encased duct banks.

END OF SECTION 260533

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SECTION 260534 - BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Boxes with covers.

1.2 RELATED SECTIONS

A. Raceways: Section 260533.

B. Access doors: Section 260503.

C. Wiring devices: Section 262726.

D. Outlet boxes where required for special systems, including Divisions 27 and 28: Provided by the equipment manufacturers of the various systems.

1.3 SUBMITTALS

A. Product data: Each type of box included in the project.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

B. Boxes:

1. Appleton/EGS Electrical Group
2. RACO/Hubbell Electrical Products
3. Steel City/Thomas & Betts

C. Wall and ceiling boxes for power and communications:

1. FSR, Inc.
2. Wiremold/Legrand

2.2 MATERIALS

A. Outlet, switch, and junction boxes:

1. Sheet metal: NEMA OS 1, sherardized or galvanized stamped.
2. Cast-metal, where required for weather-exposed or exposed locations: NEMA FB 1, aluminum, Type FD, with gasketed cover.

2.3 BOXES FOR WALLS, PARTITIONS, AND CEILINGS

A. Outlet boxes in concrete construction: Octagonal, two-piece type, of sufficient depth to keep raceways not closer than 25 mm (1 inch) to surface.

B. Toggle / snap switch and receptacle wall boxes in masonry partitions and walls: Square cornered tile wall boxes 90 mm (3.5 inches) deep, or 100 mm (4-inch) square boxes with raised tile wall device covers. The device covers shall be of extra depths required to suit the block or brick construction in which they are placed.

C. Toggle / snap switch and receptacle wall boxes in metal stud partitions: 100 mm (4 inches) square by 38 mm (1.5 inches) minimum deep boxes with 19 mm (0.75 inch) raised tile wall device covers finishing flush with finished wall surface.

D. Lighting controls station wall boxes in metal stud partitions: 100 mm (4 inches) square by 57 mm (2.25 inches) minimum deep boxes with 19 mm (0.75 inch) raised tile wall device covers finishing flush with finished wall surface.

E. Wall- and partition-mounted boxes for low-voltage systems: Same as specified above for toggle / snap switches and receptacles, except 57 mm (2.25 inch) minimum deep boxes.

F. Wall- and partition-mounted boxes for audio/visual systems: Wall box service fittings as specified below.

2.4 JUNCTION AND PULL BOXES

A. Junction and pull boxes in feeder raceway runs: Galvanized, of size required for raceway arrangement and not less than the size required by NFPA 70, and furnished with screwed covers.

B. Screws for covers: furnish stainless-steel, tamper-resistant screws for security system boxes & covers. Obtain exact specifications for screws from COTR.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide box at each outlet, switch, and appurtenance. Each box shall be of a type suitable for the duty intended and shall be installed in accordance with the manufacturer's instructions.

1. Where raceway is weather-exposed or exposed, provide cast-aluminum boxes.

B. Coordinate locations of boxes with installation of raceway as specified in Section 260533.

C. Do not install boxes back-to-back (through the wall) in partitions.

D. Firmly secure the boxes in place, plumb, level, and with front of device cover even with finished wall surface.

E. Outlet boxes used for supporting luminaires: Furnish with malleable iron fixture studs of "No-Bolt" type, secured by locknut. Provide structural channel supports for boxes occurring in ceilings. Outlets in ceilings directly on bottom of joists shall be supported independent of ceiling construction. Outlets in suspended ceilings shall not be supported from ceiling construction. Special supports for boxes shall be as directed and approved by the COTR.

F. Junction, pull, and outlet boxes for security raceways: fasten covers to boxes with stainless-steel, tamper-resistant screws.

G. Where service fittings will not permit ganging of boxes for floor outlets, outlets shall be as close as practical.

H. Provide a single cover plate where two or more devices are grouped together in one box.

I. Verify door swings with door frame installed before locating switch outlets. Locate switch(es) on opposite side of doorway from hinges.

J. Outlet boxes in fire-rated assembly:

1. Clearance between boxes and wallboard shall not exceed 3.2 mm (0.125 inch).
2. Surface area of individual outlet box does not exceed 103 square cm (16 square inches).

3. Entire surface area of boxes shall not exceed 645 square cm (100 square inches) per 9.3 sq m (100 square feet) of wall surface.

3.2 IDENTIFICATION

A. Identification on outside covers of pull and junction boxes in ceiling space or exposed on walls: Paint with colored enamel or mark with permanent waterproof black marker, or both, as specified.

1. Fire alarm system: Red.
2. Other special systems: Mark with system type, such as Data, or Security.
3. Power and lighting: Panelboard designation and circuit number(s).

B. Identification inside boxes for recess-mounted or concealed in walls and partitions: Plasticized card stock tags marked with permanent waterproof black markers.

1. Fire alarm system: Fire alarm.
2. Other special systems: Mark with system type, such as Data or Security.
3. Power and lighting: Panelboard designation and circuit number(s).

END OF SECTION 260534

SECTION 260544 - UNDERGROUND DUCTS AND UTILITY STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Ducts in directly buried duct banks.
2. Ducts in concrete-encased duct banks.

B. Related sections include the following:

1. Section 260526 for grounding electrodes, counterpoise conductors, clamps and connectors for grounding metallic manhole and handhole accessories, and testing of grounds.

1.2 REFERENCES

A. ASTM International (ASTM)

1. ASTM C 478: Precast Reinforced Concrete Manhole Sections.
2. ASTM C 857: Minimum Structural Design Loading for Underground Precast Concrete Utility Structures. Includes classes which correspond to AASHTO categories:

a. Heavy traffic: Class A-16.
b. Medium traffic: Class A-12.
c. Light traffic: Class A-8.
d. Walkway: Class A-0.3, 300 lb/sq ft (1465 kg/sq m).

B. ASTM C 858: Specification for Underground Precast Concrete Utility Structures.

C. Society of Cable Telecommunications Engineers (SCTE):

1. SCTE 77: Specification for Underground Enclosure Integrity. Light duty and pedestrian traffic only. Includes Tiers for specific applications, and static vertical wheel load ratings:

a. Tier 5: Sidewalk applications with a safety factor for occasional nondeliberate vehicular traffic.

b. Tier 8: Sidewalk applications with a safety factor for nondeliberate vehicular traffic.
c. Tier 15: Driveway, parking lot, and off-roadway applications subject to occasional nondeliberate heavy vehicular traffic.

1.3 SUBMITTALS

A. Product data: For the following:

1. Conduit and ducts, including elbows, bell ends, bends, fittings, and solvent cement.
2. Duct bank materials, including spacers and miscellaneous components.
3. Underground warning tape.

B. Coordination drawings: Show duct profiles and coordination with other utilities and underground structures. Include plans and sections drawn to scale, and show all bends and location of expansion fittings.

C. Product certificates: For concrete and steel used in underground precast manholes, according to ASTM C 858.

D. Product test reports: Indicate compliance of manholes with ASTM C 857 and ASTM C 858, based on factory inspection.

1.4 QUALITY ASSURANCE

A. Electrical components, devices, and accessories (including ducts for communications service): 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 ANSI C2.

C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

1.6 PROJECT CONDITIONS

A. Existing utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify COTR at least twenty-one days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without COTR written permission.

1.7 COORDINATION

A. Coordinate layout and installation of ducts, manholes, and handholes with final arrangement of other utilities and site grading, as determined in the field.

B. Coordinate elevations of ducts and duct bank entrances into manholes and handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure duct runs drain to manholes and handholes, and as approved by COTR.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

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. Nonmetallic ducts and accessories:

a. ARNCO Corp.
b. Beck Manufacturing Inc.
c. Cantex, Inc.
d. CertainTeed Corp.; Pipe & Plastics Group.
e. ElecSys, Inc.
f. Electri-Flex Co.
g. IPEX, Inc.
h. Lamson & Sessions; Carlon Electrical Products.
i. Manhattan/CDT
j. Spiraduct/AFC Cable Systems, Inc.

2.2 CONDUIT

A. Conduit and fittings are specified in Section 260533.

2.3 DUCTS

A. Rigid nonmetallic conduit: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.4 ACCESSORIES

A. Duct spacers: Rigid, nonmetallic, horizontally and vertically interlocking spacers, selected to provide minimum duct spacings and cover depths indicated while supporting ducts during concreting and backfilling.

B. Grounding materials: Comply with Section 260526.

C. Duct sealing compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and of adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

D. Warning tape: Underground-line warning tape specified in Section 260553, Identification for Electrical Systems.

E. Pull rope: polypropylene, minimum 0.1875 inch (5 mm) thick, tensile strength 3559 N (800 lbs), work load 578 N (130 lbs).

2.5 CONSTRUCTION MATERIALS

A. Concrete: Use 20.7-MPa (3000-psi) minimum, 28-day compressive strength and 10-mm (0.375-inch) maximum aggregate size. Concrete and reinforcement are specified in Division 03 Section “Cast-in-Place Concrete.”

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Underground ducts for electrical feeders higher than 600 V: Type EPC-40-PVC, duct bank, concrete-encased.

B. Underground ducts for electrical feeders 600 V and below and for communications outside plant cable: Type EPC-40-PVC, duct bank, concrete-encased where indicated.

C. Underground ducts for electrical branch circuits 600 V and below: Type EPC-40-PVC, directly buried duct bank, except concrete-encased when crossing roads.

D. Underground ducts for communication circuits: Type EPC-40-PVC, directly buried duct bank, except concrete-encased when crossing roads.

3.2 EARTHWORK

A. Excavation and backfill: Comply with Section 260501, Excavation and Fill for Electrical Work, but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Section specifying Landscaping.

D. Restore disturbed pavement. Refer to “Cutting and Patching” in Section 260101.

3.3 CONDUIT AND DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes or handholes to drain in both directions.

B. Curves and bends: Use manufactured rigid steel elbows for stub-ups at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of 7.5 m (25 feet), both horizontally and vertically, at other locations.

C. Use solvent-cement joints in ducts and fittings and make watertight according to manufacturer’s written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

D. Building entrances: Make a transition from underground duct to rigid steel conduit at least 3 m (10 feet) outside the building wall. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below:

1. Concrete-encased ducts: Install reinforcement in duct banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building wall.
2. Waterproofed wall and floor penetrations: Install a watertight entrance-sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight.

E. Concrete-encased, nonmetallic ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator installation: Space separators close enough to prevent sagging and deforming of ducts and secure separators to earth and to ducts to prevent floating during concreting. Stagger spacers approximately 150 mm (6 inches) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct bank application. Pour each run of envelope between manholes or other terminations in one continuous operation. If more than one pour is necessary, terminate each pour in a vertical plane and install 19-mm (0.75-inch) reinforcing rod dowels extending 450 mm (18 inches) into concrete on both sides of joint near corners of envelope.
3. Reinforcement: Reinforce duct banks where they cross disturbed earth and where indicated.
4. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
5. Minimum clearances between ducts: 75 mm (3 inches) between ducts and exterior envelope wall, 50 mm (2 inches) between ducts for like services, and 100 mm (4 inches) between power and signal ducts.
6. Depth: Install top of duct bank at least 600 mm (24 inches) below finished grade in nontraffic areas and at least 750 mm (30 inches) below finished grade in vehicular traffic areas, unless otherwise indicated.

F. Directly buried ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator installation: Space separators close enough to prevent sagging and deforming of ducts.
2. Install expansion fittings as shown on shop drawings.
3. Trench bottom: Continuous, firm, and uniform support for duct bank. Prepare trench bottoms as specified in Section 260501, Excavation and Fill for Electrical Work.
4. Backfill: Install backfill as specified in Section 260501, Excavation and Fill for Electrical Work. After installing first tier of ducts, backfill and compact. Repeat backfilling after placing each tier. After placing last tier, hand-place backfill to 100 mm (4 inches) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, complete backfilling normally.
5. Minimum clearances between ducts: 75 mm (3 inches) between ducts for like services and 150 mm (6 inches) between power and signal ducts.
6. Depth: Install top of duct bank at least 600 mm (24 inches) below finished grade, unless otherwise indicated.

G. Warning tape: Bury warning tape approximately 300 mm (12 inches) above all concrete-encased duct banks. Align tape parallel to and within 75 mm (3 inches) of the centerline of duct bank.

H. Stub-ups: Use rigid steel conduit for stub-ups to equipment. For equipment mounted on outdoor concrete bases, extend steel conduit a minimum of 1.5 m (5 feet) from edge of base. Install insulated grounding bushings on terminations. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 75 mm (3 inches) of concrete.

I. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 1.03 Mpa (15-psig) hydrostatic pressure.

J. After raceways are installed, fish pull rope. After completion of the work of this project, pull rope shall remain in ducts identified as to be left empty. For each empty raceway, these ropes shall be of the same size, strength, and material as the ropes used to pull cables and conductors through similar raceways of the project. Leave 150 mm (six inches) at each end of the pull ropes, tied off to the raceways or fastened to the inside of removable caps.

3.4 FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

B. Duct integrity: Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of the duct. If obstructions are indicated, remove obstructions and retest.

C. Correct installations if possible and retest to demonstrate compliance. Remove and replace defective products and retest.

3.5 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes electrical identification materials and devices required to comply with ANSI, NFPA, and OSHA standards.

B. This section addresses identification of electrical equipment, raceways, boxes, conductors, and other related electrical system components.

1.2 SECTION INCLUDES

A. Identification for raceways and cables.

B. Identification of power conductors and control cables.

C. Identification of equipment and instructions.

D. Miscellaneous identification products.

1.3 RELATED SECTIONS

A. Sections in Divisions 26, 27 and 28.

1.4 REFERENCES

A. ANSI Z535.4: Standard for Product Safety Signs and Labels.

B. ANSI/IEEE C2: National Electrical Safety Code.

C. NFPA 70: National Electrical Code.

D. NFPA 70E: Standard for Electrical Safety in the Workplace.

E. OSHA 29 CFR 1910.144: Safety Color Code for Marking Physical Hazards.

F. OSHA 29 CFR 1910.145: Specifications for Accident Prevention Signs and Tags.

G. UL 969: Standard for Marking and Labeling Systems.

1.5 SUBMITTALS

A. Product data: For each type of electrical identification product.

1.6 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with OSHA standards.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.7 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other sections requiring identification applications, drawings, shop drawings, manufacturer's wiring diagrams, and the operation and maintenance manual; and with those required by codes, standards, and safety regulations. Use consistent designations throughout Project.

B. Coordinate installation of identification materials and devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identification materials and devices with location of access panels and doors.

D. Install identifying materials and devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following manufacturers, or approved equal:

1. Brady USA, Inc.

2. Carlton Industries
3. Graphic Products, Inc.
4. Ideal Industries, Inc.
5. Panduit Corporation
6. Presco
7. Seton Identification Products
8. Thomas & Betts Company
9. Utility Safeguard

2.2 GENERAL PRODUCT REQUIREMENTS

A. Except where otherwise indicated, provide manufacturer's standard identification products of category and type suitable for each application. Where more than one identification method is specified for an application, the Installer shall select and utilize each material in a consistent manner.

2.3 RACEWAY IDENTIFICATION

A. Comply with ANSI A13.1 for minimum lettering size, length of color field, and coloring schemes for each raceway size, type, and location.

1. Colors: Black letters on Orange field.
2. Legend: Raceways carrying the following:

    a. Power circuits less than 600V: Indicate system voltage.
    b. Power circuits greater than 600V: Indicate warning and system voltage. (Example – "DANGER – 13,200 VOLTS").
    c. Low-voltage systems less than 50V: Indicate system type (Example – "TELECOMMUNICATIONS").

B. Adhesive labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear weather- and chemical-resistant coating.

C. Wrap-around marker bands: Diameter sized to suit raceway or cable it identifies.

1. Plastic color-coded, pretensioned, grip-type, flexible, acrylic sleeve.

2.4 CONDUCTOR AND CABLING IDENTIFICATION

A. Adhesive labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

B. Color-coded, adhesive tape: Self-adhesive, vinyl tape, in appropriate colors for system voltage and phase.

C. Marker tapes: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

2.5 EQUIPMENT IDENTIFICATION

A. Engraved plastic nameplates: Laminated plastic, engraved, white letters on black background, except where other color schemes are noted or specified.

1. Size: Minimum 19 mm (0.75-inch) by 64 mm (2.5-inches).
2. Letter size: Minimum height of 10 mm (0.375-inch).
3. Mechanically fastened, except adhesive mounted where necessary due to substrate.

    a. Mechanical fastener: Punched or drilled, with vandalproof stainless steel or brass screws or rivets.

B. Exterior, metal-backed, signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate (CAB) signs with galvanized steel backing; punched or drilled for fasteners with corner grommets; with colors, legend, and size required for application.

C. Adhesive film label: Machine-printed, black letters on white background, through thermal transfer or equivalent process, with clear weatherproof and UV-resistant covering. Minimum letter size height of 10 mm (0.375-inch).

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Underground warning tape: Permanent, bright-colored, continuous-printed, vinyl tape for use with underground cables, raceways, and ductbanks. Comply with ANSI Z535.

1. Not less than 152 mm wide by 0.102 mm thick (6-inches wide by 4 mils thick).
2. Tape Material:

    a. Made of metal detectable polyester or vinyl.
    b. Compounded for permanent direct-burial service. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to destructive substances commonly found in soils.

3. Printed legend with black lettering, indicating type of underground line.

a. Provide inscriptions for power cabling with red-colored tape: Example – "CAUTION – BURIED ELECTRIC LINE BELOW".
b. Provide inscriptions for low-voltage system cabling with orange-colored tape: Example – "CAUTION – BURIED FIBER OPTIC LINE BELOW".

B. Wiring device tape labels:

1. Adhesive film label: Machine-printed, black letters on clear background, through thermal transfer or equivalent process. Minimum letter size height of 6 mm (0.25-inch).

a. Labeling for electrical devices and components such as receptacles, switches, control device stations, manual motor starters, network and phone jacks, junction and pull boxes, etc.

C. Warning labels and signs:

1. Self-adhesive warning labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configures for display on front cover, door, or other access to equipment unless otherwise noted.
2. Fasteners: Self-tapping, stainless-steel screws or, stainless-steel machine screws with nuts, flat and lock washers.

D. Cable ties: Fungus-inert, self-extinguishing, one-piece, self-locking, color-coded, nylon cable ties suitable for the application (general purpose, UV-stabilized outdoor, or plenum rated).

E. Adhesive: Heavy-duty, thermo-resistant, industrial grade adhesive, for adhesion to any surface without identification curling, peeling, or falling off.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification products at locations for most convenient viewing without interference with operation and maintenance of equipment.

1. For finished public spaces, coordinate identification product mounting locations COTR.

C. Existing equipment: Apply identification products to unmarked existing equipment where work is being performed.

D. Apply identification products to surfaces after equipment finish work has been completed.

E. Clean surfaces before applying identification products, using materials and methods recommended by manufacturer of identification device.

F. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

G. System identification labeling for raceways and cables: Each label shall be installed on sidewall of raceway and easily placed for proper identification. Locate labels at changes in direction, at penetrations of walls and floors, at 15-m (50-foot) maximum intervals in straight runs, and at 7.6-m (25-foot) maximum intervals in congested areas.

H. System identification color-coding bands for raceways and cables: Each color-coding band shall completely encircle cable or raceway. 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 15-m (50-foot) maximum intervals in straight runs, and at 7.6-m (25-foot) maximum intervals in congested areas.

I. Cable ties: For attaching tags, use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In spaces handling environmental air: Plenum rated.
3. Handholes: Nylon or wire ties.

J. Underground-line warning tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 150 to 200 mm (6 to 8 inches) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 400 mm (16 inches) overall.

3.2 APPLICATION

A. Miscellaneous:

1. Access doors and panels: Apply engraved nameplate labels at access doors identifying concealed electrical item. Do not locate labels in finished, public spaces.
2. Available fault current labels: Refer to Section 260573, Overcurrent Protective Device Studies, for fault current labeling requirements.

3. Arc flash warning labels: Refer to Section 260573, Overcurrent Protective Device Studies, for arc flash labeling requirements.

B. Junction and pull boxes:

1. Label each junction and pull box, identifying circuit designation or type of system.

    a. Exposed boxes: Place label on cover, externally visible.
    b. Concealed boxes: Place label or tag on inside cover of box.
    c. Junction boxes concealed above suspended ceilings or exposed in non-occupied spaces may be marked with permanent ink marker in lieu of printed labels.

2. Boxes with conductors greater than 600V: Apply labels identifying nominal system voltage on cover and minimum of one fixed side. One label shall be visible from the floor where boxes are installed exposed.
3. Fire alarm system boxes shall have red finish. Boxes shall be prefinished prior to installation.

C. Raceway identification: Apply identification products for each raceway.

1. Apply color-coded identification products to raceways as follows:

    a. Normal power system: None.
    b. Standby/emergency power system: Orange.
    c. Fire alarm system: Red, solid colored.
    d. Telecommunications system: None.
    e. Security System: blue, color banded.

2. Apply labels identifying nominal system voltage for the raceways containing feeders. Labeling of raceways with branch circuit conductors is not required.
3. Apply system identification labels identifying type of system for low-voltage system raceways.
4. Apply circuit designation markings on each feeder and branch circuit raceway entering and leaving each panelboard and switchboard. Mark raceway clearly with permanent ink marker or printed labels.
5. Empty raceways: Apply labels indicating description of empty raceways (i.e., spare, future use) and identifying the beginning and end locations. Mark raceway clearly with permanent ink marker or printed labels.
6. Abandoned raceways: Apply labeling indicating raceway has been abandoned.

D. Wiring and cabling identification:

1. Power circuit conductor identification, 600 V or less: Apply color-coded identification for cables, feeders, and power circuit conductors exposed in accessible vaults, junction and pull boxes, utility structures, and equipment enclosures. Apply color-coding scheme as indicated below throughout the building's network of feeders and circuits, unless otherwise required by the authority having jurisdiction.

    a. Colors on conductors No. 10 and smaller, or No. 6 and smaller for grounded and grounding conductors: Solid colored insulation.
    b. Colors on conductors No. 8 and larger, or No. 4 and larger for grounded and grounding conductors: Apply colored tape wrapped a minimum of 150 mm (6 inches) on either end of conductor and in boxes where splices or taps are made.
    c. Conductors used solely for grounding purposes shall be green, if insulated.
    d. Where multi-conductor cables are used, use same color coding system for identification of wiring.

COLOR CODE (600 V Max.)				
VOLTAGE	NEUTRAL	PHASE		
		A	B	C
120-V, 2-wire	White	Black, Red, or Blue depending on phase		
208/120-V wye, 3-phase, 4-wire	White	Black	Red	Blue

2. Conductors for future use: Attach tags with circuit designation for conductors to be extended for future use.
3. Control and low-voltage system wiring shall be coded with colors and markings different from those used to designate phase wires.

E. Wiring device labels: For wiring devices such as receptacles, devices installed in surface raceway assemblies, and other wiring devices operating at or greater than 120V.

1. Apply adhesive film labels on outside of wiring device coverplates identifying circuit designation serving device.
2. For special receptacle configurations, apply label identifying applicable device NEMA configuration designation in location not concealed by plug.
3. Apply labels to devices serving low-voltage system devices including the following:

    a. Fire alarm devices and test stations: Circuit designation.
    b. Telecommunications device stations: Work area outlet designation.
    c. Audio-visual device stations: Device designation.
    d. Security device stations: Device designation.

F. Equipment identification: Install unique designation label consistent with contract documents and shop drawings.

1. Labeling instructions:

    a. Engraved plastic laminate nameplates, unless otherwise indicated.
    b. Unless otherwise required, provide a single line of text with 13 mm (0.5-inch) high lettering on 38-mm (1.5-inch) high label. Where two or more lines are required, use single label with increased height.
    c. For multi-section or multi-compartment equipment, apply labels identifying each compartment or section.
    d. For fusible equipment, identify fuse type and size on the front cover.
    e. For enclosed circuit breaker equipment, identify device trip rating where rating is not visible.
    f. Where equipment has only one source of power the location and circuit designation of the power source shall be clearly identified at the equipment location.
    g. Where equipment has more than one source of power (i.e., transfer switch, separate control power source), the location and circuit designation of each power source shall be clearly identified at the equipment location.

2. Apply nameplates and labels to equipment according to the below identification schemes:

    a. Identify available fault current and calculation date. Apply products to the following equipment:

        (1) Panelboards

    b. Identify equipment designation; voltage rating; phase and number of wires; and designation and location of load served. Apply products to the following equipment:

        (1) Panelboards

    c. Identify equipment designation; primary and secondary voltage ratings; phase and number of wires; circuit designation and location of primary source; and designation and location of load served. Apply products to the following equipment:

        (1) Disconnect switches
        (2) Enclosed circuit breakers
        (3) Contactors
        (4) Motor starters and combination motor starter-disconnects

d. Identify equipment designation; and circuit designation and location of primary source. Apply products to the following equipment:

(1) Monitoring and control equipment
(2) Control stations
(3) Fire alarm control panels and auxiliary equipment
(4) Security panels and auxiliary equipment

3. Nameplates shall incorporate white lettering on colored backgrounds based on the following color-coding scheme:

a. Normal power system: Black background.
b. Emergency power system: Red background.
c. Optional-standby power system: Orange background.

4. Buttons, dials, and other control interfaces: label each button, dial, and other control interface with its function. If an interface has no function, label it “spare”.

G. Working space requirements: Identify required working clearances at electrical equipment. Working clearance dimensions shall be in compliance with NFPA 70 and OSHA regulations.

1. Working space labels, markers, and signs: Apply permanent labels, markers, or signs at the following locations with appropriate message indicating required working clearances.

a. Apply identification products to electrical equipment installed in unfinished spaces such as mechanical, electrical, and storage rooms. Do not install identification products at equipment installed in finished or public spaces unless otherwise indicated.
b. Equipment likely to require examination, adjustment, servicing, or maintenance while energized.
c. Electrical distribution equipment including the following: panelboards, disconnect switches, and motor controllers.

H. Warning and caution labels and signs:

1. Apply warning and caution labels on equipment in accordance with NFPA 70 and 70E, ANSI, and OSHA requirements including arc flash hazard warning labels and special clearance requirements.
2. Apply warning and caution labels and signs at locations where safe operation and maintenance of electrical system equipment is of concern.

3. Apply warning signs on electrical room doors in accordance with NFPA 70 and 70E, ANSI, and OSHA requirements. Where doors are located in finished, public areas, located sign on the inside of the door. Coordinate mounting requirements with door type.

I. Underground warning tape: Apply underground warning tape above underground ductbanks, raceway, or direct-buried cable.

J. Operating instruction signs:

1. Apply instruction signs at locations where directions for safe operation and maintenance of electrical system equipment are necessary. Apply approved text where instructions are needed for proper system operation.

a. Emergency instructions: Provide white text on red background.

3.3 FIELD QUALITY CONTROL

A. Coordinate names, abbreviations, colors, and other designations with construction documents, submittals, and applicable code and standards requirements. Utilize consistent designations and identification techniques throughout project.

B. Install identification products at locations that are clearly visible at normal viewing angles and without interference with operation and maintenance of the equipment.

C. Install identification products in a neat and clean, professional manner where products are securely attached and oriented parallel to equipment edges.

END OF SECTION 260553

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SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE STUDIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical system fault-current and protective device study:

1. Fault-current analysis.
2. Arc flash hazard analysis.

B. For portions of the electrical distribution system affected by the work of this project, including all new distribution components and all portions of the distribution system upstream of the new components, perform overcurrent protective device studies to determine the required fault current rating, coordination settings, and arc flash hazards.

1.2 RELATED SECTIONS

A. Sections in Division 26.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE):

1. IEEE 3001.3 – Recommended Practice for the Design of Industrial and Commercial Power Systems.
2. IEEE 3001.5 - Recommended Practice for the Application of Power Distribution Apparatus in Industrial and Commercial Power Systems
3. IEEE 3002.2 – IEEE Recommended Practice for Conducting Load-Flow Studies of Industrial and Commercial Power Systems.
4. IEEE 3002.3 – IEEE Recommended Practice for Conducting Short-Circuit Studies of Industrial and Commercial Power Systems
5. IEEE 3004.5 – IEEE Recommended Practice for the Application of Low-Voltage Circuit Breakers in Industrial and Commercial Power Systems
6. IEEE 3004.7 – IEEE Recommended Practice for Conductor Protection in Industrial and Commercial Power Systems.
7. IEEE 1584 - Guide for Performing Arc flash Hazard Calculations.

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
4. ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. National Fire Protection Association (NFPA):

1. NFPA 70 – National Electrical Code, latest edition.
2. NFPA 70E – Standard for Electrical Safety in the Workplace.

D. Occupational Safety and Health Administration (OSHA):

1. OSHA 29 Code of Federal Regulations (CFR) Part 1910, Subpart S.

1.4 SUBMITTALS

A. Product data: For computer software to be used to perform studies.

B. Product certificates: For coordination-study and fault-current analysis computer software programs, certifying compliance with IEEE 3002.2 and IEEE 3002.3.

C. Qualifications:

1. Submit evidence indicating individual and organization compliance with requirements indicated in “Quality Assurance” below.

D. Preliminary electrical system study: Submit for review before distribution equipment shop drawings have been submitted, and before equipment order has been released to the manufacturer.

1. If formal completion of the study may delay the project schedule, COTR may approve use of the preliminary draft for ordering equipment.
2. If approved for use in ordering equipment, preliminary draft shall include sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.

E. Final electrical system study:

1. Submit final report for review and record.

2. Incorporate changes resulting from deficiencies and corrections of preliminary draft report.

F. Reports:

1. Electrical system study report: Submit reports required above including the following items:

   a. General report information: Scope, definitions, descriptions, assumptions, and other information necessary to properly interpret results of the report.
   b. Tabulated summary comparing protective device ratings and calculated available fault-current levels.
   c. Tabulated summary of protective device settings including circuit breaker, fuse, and relays.
   d. Fault-current analysis calculations.
   e. Arc flash hazard calculations including details of the incident energy and flash protection boundary calculations.
   f. Recommendations for system improvements.
   g. System one-line diagram.
   h. Input and output data used for each component and for study calculations.

2. Submit final reports as electronic files in portable document format (.pdf) to Owner. Submit program base files in file format of computer software utilized to perform study.

1.5 QUALITY ASSURANCE

A. Electrical system study shall be performed by one or more independent qualified organizations, and under the supervision and approval of a Registered Professional Engineer skilled in performing and interpreting the power system studies.

B. Qualifications of organization performing electrical system study: 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. Registered Professional Engineer shall be a full-time employee of the equipment manufacturer or of an approved engineering firm.
2. Registered Professional Engineer shall have a minimum of five (5) years of experience in performing power system studies and registered in the state where the project is located.

C. Qualifications of computer-based software: Widely available, complying with standards, guides, and codes as referenced above.

D. Comply with IEEE 3002.3 for general study procedures.

E. Comply with IEEE 3001.5 for short-circuit currents and coordination time intervals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Computer software: Subject to compliance with requirements, utilize product by one of the following:

1. EDSA Micro Corporation
2. Operation Technology, Inc.
3. SKM Systems Analysis, Inc. (Basis of Design)

2.2 COMPUTER SOFTWARE REQUIREMENTS

A. Comply with IEEE 3002.2 and 3002.3.

B. Computer software program shall be capable of performing fault-current analysis of project electrical distribution system.

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.

D. Computer software program shall be capable of performing arc fault hazard analysis using equations as established by IEEE 1584 and requirements presented in NFPA 70E, Annex D.

E. Software shall include a comprehensive equipment library of manufacturer-based and IEEE / ANSI based equipment to accurately model the electrical distribution system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine project submittals for compliance with electrical distribution system requirements outlined on the drawings and in electrical specification sections.

3.2 SYSTEM DATA COLLECTION

A. The Contractor shall furnish all data required to perform the power system studies. The Engineer performing the fault analysis, protective device coordination, and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to ensure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

1. Where data for available fault current and overcurrent protection on existing upstream equipment is not available despite the best efforts of the Contractor, the Engineer may make conservative assumptions. Assumptions and the rationale behind them

B. If applicable, include fault contribution of existing motors and equipment in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

C. The Engineer performing the studies shall gather and tabulate input data necessary to support each study including the following:

1. Product data for each component of the electrical distribution system.
2. Utility available fault contribution and impedance values.
3. Drawings, one-line, and riser diagrams showing system configuration, equipment designations, feeder lengths, and other applicable system characteristics.
4. List of assumptions and an explanation for the reasoning behind each assumption.

3.3 SYSTEM FAULT CURRENT ANALYSIS

A. Calculate the maximum available short-circuit momentary current and interrupting duties in amperes rms symmetrical for electrical power distribution system components. The calculation shall be performed for current immediately after initiation and for a three-phase bolted fault at each of the following locations:

1. Distribution panelboards.
2. Branch circuit panelboards.
3. Generator output terminals.
4. Automatic transfer switch terminals.

B. Study the project's electrical distribution system from normal and alternate power sources throughout electrical distribution system. Where system configuration allows multiple switching and operation arrangements through paralleled sources, tie-breakers, or closed-transition switches, include study that results in maximum fault conditions.

C. For grounded systems, provide line-to-ground fault current values for areas as defined above for the three-phase, bolted fault, short-circuit study.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 3001.3, IEEE 3001.5, IEEE 3002.3, IEEE 3004.5, and IEEE 3004.7.

E. Study report:

1. Input data: Gather and provide the following input data, in tabular or graphic form, used to perform fault calculations and other studies in this section.

    a. Utility three-phase and line-to-ground available contribution with associated X/R ratios.
    b. Short-circuit reactance of rotating machines with associated X/R ratios.
    c. Cable type, construction, size, quantity per phase, length, impedance and conduit type.
    d. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio.
    e. Circuit breaker types and sizes.

2. Methods and assumptions: Indicate calculation methods and assumptions that may have been used to perform analysis.
3. Results: Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram. Provide the following in a table format:

    a. Source fault impedance and generator contributions
    b. X/R ratios
    c. Asymmetry factors
    d. Motor contributions
    e. Short circuit KVA
    f. Symmetrical and asymmetrical fault currents

4. Equipment evaluation and conclusions:

    a. Verify interrupting ratings and withstand ratings are equal to or higher than calculated fault current levels.

b. Verify adequacy of phase conductors at maximum three-phase, bolted fault currents.
c. Verify adequacy of equipment grounding conductors and grounding electrode conductors for grounded systems at maximum ground-fault currents.

5. Recommendations: List recommendations for equipment with inadequate ratings. Notify COTR in writing of existing equipment improperly rated for the calculated available fault current of the system.

3.4 AVAILABLE FAULT CURRENT LABELS

A. Provide a machine printed adhesive label on the enclosure for each switchgear, switchboard, and panelboard. The label shall include the following information, at a minimum:

1. Available fault current
2. Calculation date

B. Labels will be based on calculated maximum available short-circuit momentary current and will be provided after the results of the analysis have been presented to the Owner and after any system changes, upgrades or modifications have been incorporated in the system.

C. Labels shall be in compliance with NFPA 70E and OSHA standards.

3.5 SYSTEM ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (such as switchgear, switchboards and panelboards) where work could be performed on energized parts.

C. The arc flash hazard analysis shall include electrical equipment locations where work such as examination, adjustment, service, or maintenance could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary considering incident energy of 1.2 cal/cm^2.

E. 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. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

F. 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).

    1. Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum number of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

G. 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 and generators should be decremented as follows:

    1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
    2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

H. 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.

I. 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.

J. 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.

K. 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. 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.

L. Incident energy and flash protection boundary calculations:

1. Arcing fault magnitude
2. Device clearing time
3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy
7. Hazard Risk Category

3.6 ARC FLASH WARNING LABELS

A. The Contractor and organization performing the Arc Flash Hazard Analysis shall provide an 89 mm x 127 mm (3.5 inch x 5 inch) thermal transfer type label of high adhesion polyester for each work location analyzed.

B. Labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the Owner and after any system changes, upgrades or modifications have been incorporated in the system.

C. The label shall include the following information, at a minimum:

1. Location designation
2. Nominal voltage
3. Flash protection boundary
4. Hazard risk category
5. Incident energy
6. Working distance
7. Engineering report number, revision number and issue date

D. Labels shall be machine printed, with no field markings.

E. Labels shall be in compliance with NFPA 70E and OSHA standards.

F. Provide arc flash labels in the following manner based on recommended overcurrent device settings.

1. For each applicable 208V panelboard, one arc flash label shall be provided.

3.7 FIELD QUALITY CONTROL

A. Field adjustment: Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Notify COTR in writing of any required equipment modifications.

END OF SECTION 260573

SECTION 260923 - LIGHTING AND RECEPTACLE CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Toggle / snap switches for lighting.

B. Time-based control devices.

C. Outdoor motion sensors.

D. Device programming requirements.

1.2 RELATED SECTIONS

A. Commissioning requirements: Division 01.

B. Identification: Section 260553.

C. Interior lighting: Section 265100.

D. Exterior lighting: Section 265600.

1.3 REFERENCES

A. IECC: International Energy Conservation Code

B. NECA 1: Standard Practices for Good Workmanship in Electrical Construction.

C. NFPA 70: National Electrical Code.

1.4 SUBMITTALS

A. Product data: Each type of device used in the project.

B. Bill of materials: Provide detailed list of components and quantities.

C. Field quality control test reports.

D. Operation and maintenance data: For lighting controls system and associated components, provide product data, shop drawings, and test reports in operation and maintenance manual. In addition to items specified in Division 01, include list of replacement parts and assemblies.

1.5 QUALITY ASSURANCE

A. Devices shall be UL listed and labeled for their intended application.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store components indoors in a clean dry space with uniform temperature to prevent condensation. Protect devices from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.7 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor's and subcontractors' responsibilities are described in Division 01.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

2.1 TOGGLE / SNAP SWITCHES FOR LIGHTING

A. Manufacturers:

1. Arrow Hart/Eaton Wiring Devices
2. Hubbell/Bryant Electric
3. Legrand/Pass & Seymour (P&S)
4. Leviton Manufacturing Co.
5. Mulberry Metal Products
6. Signify

B. Toggle / snap switches: Specification grade conforming to UL 20 or UL508 as applicable:

1. General-use: Single-pole, 20 amperes, 120/277 volts:

a. Basis of design: P&S PS20AC1, PS20AC3 (3-way), PS20AC4 (4-way), industrial extra heavy-duty.
b. Color: Brown

C. Device covers: Type 302 stainless steel (indoor), painted aluminum (outdoor)

1. Outdoor weatherproof cover with actuating lever mounted directly over general-use toggle switch basis of design: Mulberry 30489 (single gang for FS box), Mulberry 30496 (two-gang).

2.2 TIME-BASED CONTROL DEVICES

A. Digital time clock / time switch: Equal to TORK/NSi Industries, catalog number EWZ201, UL 917 listed, electronic 7-day time switch, microprocessor-based, solid-state, two-channel control, with LCD display and automatic tracking of sunrise and sunset times in order to automatically turn lights ON at sunset and OFF at sunrise.

1. Input voltage: 120/277 volts AC.
2. Output dry contacts: 30 amperes at 120 volts AC; 20 amperes at 277 volts AC.
3. Scheduling: Twenty ON and OFF set points, capable of different schedules each day of the week.
4. Sunset astronomic: Adjusts daily to changes in sunset times. Adjustable from 10 to 60 degrees, northern or southern latitudes. Can be individually offset plus/minus 1-240 minutes from both sunset and sunrise times.
5. Daylight savings: Automatic adjustment.
6. Leap year: Automatic compensation.
7. Manual override: Until the next regularly scheduled ON or OFF, automatic operation then resumes.
8. Clock format: AM/PM.
9. Power outage backup: Permanent schedule retention. Capable of operating during a power outage for 4 days with an integral supercapacitor.
10. Enclosure: Polycarbonate indoor/outdoor NEMA 250 Type 3R with lockable hasp.

2.3 OUTDOOR COMBINATION MOTION SENSOR / PHOTOCELL / RELAYS

A. Acceptable manufacturers:

1. Acuity Brands Lighting, Inc.
2. Hubbell Control Solutions
3. Leviton Manufacturing Co.
4. Lutron Electronics Co., Inc.
5. Signify/Cooper Lighting LLC.

6. Wattstopper/Legrand

B. Description: Solid-state outdoor motion sensor, photocell, and relay. Basis of design is the Wattstopper FSP-212.

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction.
2. PIR type, weatherproof.
3. Switch Rating: 800 watts tungsten at 120 volts.
4. Switch Type: single pole.
5. Voltage: 120 V type.
6. Field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus70 deg C (minus 40 to plus 158 deg F).

2.4 DEVICE PROGRAMMING REQUIREMENTS

A. Refer to lighting controls diagrams and schemes on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install devices in complete compliance with manufacturer’s recommendations.

B. Provide a single cover plate where two or more devices are grouped together in one box.

C. Ground components according to Section 260526, Grounding and Bonding.

D. Devices shall be installed and programmed to meet the control intent.

3.2 INSTALLING OCCUPANCY SENSORS

A. Install in accordance with manufacturer’s written instructions.

B. Coverage pattern: Verify coverage pattern of a single detector or system of detectors to be capable of complete coverage of the space in which the lighting is intended to be controlled. Provide additional detectors as necessary to satisfy complete coverage. Wire detectors in parallel so that if any is active, all associated luminaires turn on.

C. Install outdoor motion sensors where shown on drawings.

1. Provide enclosures as needed to make detectors waterproof.
2. Provide lenses as needed to achieve coverage.

D. Programming requirements: occupancy mode unless otherwise indicated on the drawings.

1. Occupancy mode (automatic on, automatic off).
2. Built-in photocell shall disable motion sensor during day, so luminaires only turn on at night.

3.3 IDENTIFICATION

A. Materials: Refer to Section 260553, "Identification for Electrical Systems." Identify devices and wiring.

3.4 FIELD QUALITY CONTROL

A. Functional testing: Perform tests and prepare test reports for the following:

1. Occupancy sensors: Confirm that the placement, sensitivity, and time-out settings are optimized to ensure lights turn off only after each space is vacated and do not turn on unless the space is occupied.
2. Digital time clock / time switch: Confirm lights are turning on and off as programmed. Confirm time settings with COTR and document device settings.
3. Fully document control device calibration settings and submit information as a part of the operation and maintenance data.

END OF SECTION 260923

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Circuit breaker panelboards, distribution and lighting and appliance branch-circuit types.

1.2 RELATED SECTIONS

A. Identification for electrical systems: Section 260553.

B. Overcurrent protective device studies: Section 260573.

1.3 REFERENCES

A. ANSI/NECA 407: Recommended Practice for Installing and Maintaining Panelboards.

B. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA PB 1: Panelboards.

D. NEMA PB 1.1: Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

E. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

F. UL 50: Enclosures for Electrical Equipment.

G. UL 67: Panelboards.

H. UL 1449: Surge Protective Devices.

1.4 DEFINITIONS

A. Circuit-breaker panelboards in this section:

1. Distribution panelboard: Capable of accepting up to 1200-ampere branch circuit breakers.
2. Lighting and appliance panelboards: Maximum branch circuit breaker amperage:

a. 120/208-volt panelboards: 100 amperes.

1.5 SUBMITTALS

A. Product data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated.

B. Bill of materials: Provide detailed list of components.

C. Shop drawings: For each type of panelboard, include the following details:

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings in panel schedule format.
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. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

D. Operation and maintenance data: For panelboards and components to include in operation and maintenance manuals. In addition to items specified in Division 01 and Section 260101, 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.
3. Copy of each printed panelboard schedule representing final version following installation.

1.6 QUALITY ASSURANCE

A. Do not submit equipment submittals prior to completing Short-Circuit and Coordination Study as indicated in Section 260573.

B. Source limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

C. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency accepted by the authority having jurisdiction, and marked for intended location and application; listed as a complete assembly.

1. UL label and local testing (where required): As specified in Section 260500, Common Work Results for Electrical.

D. Comply with referenced standards and listings previously identified including NEMA PB 1, NFPA 70, and UL 67.

1.7 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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.9 PROJECT CONDITIONS

A. Interruption of existing electrical service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify COTR no fewer than fourteen days in advance of proposed interruption of electrical service. Provide applicable details of proposed outage including sequence of work and methods of providing temporary electrical service.
2. Do not proceed with interruption of electrical service without written permission.

B. Environmental limitations:

1. Do not deliver or install NEMA 1 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: Not exceeding minus 30 degrees C (minus 22 degrees F) to plus 104 degrees F (plus 40 degrees C).
b. Altitude: Not exceeding 2000 m (6600 feet).

1.10 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. Furnish spare breakers for panelboards as indicated in schedule on drawings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Circuit breaker panelboards: Subject to compliance with requirements, provide circuit breaker panelboards manufactured by Schneider Electric; Square D products or comparable product by one of the following:

1. ABB; General Electric products
2. Eaton Corporation
3. Schneider Electric; Square D products
4. Siemens Industry, Inc.

B. Fusible branch circuit panelboards: Subject to compliance with requirements, provide fusible branch circuit panelboards manufactured by Eaton Corporation; Bussmann products or comparable product by one of the following:

1. ABB; General Electric products
2. Eaton Corporation; Bussmann
3. Littelfuse, Inc.
4. Mersen
5. Schneider Electric; Square D products
6. Siemens Industry, Inc.

2.2 PANELBOARDS, GENERAL

A. UL listing: UL 67, listed and labeled.

B. Integrated equipment short-circuit rating: Each panelboard, as a complete unit, shall have a short-circuit rating equal to or greater than the integrated equipment rating shown or scheduled on the drawings.

1. Rating shall be established by testing in accordance with UL 67, with the overcurrent devices mounted in the panelboard. Make short-circuit tests on the overcurrent devices and on the panelboard structure simultaneously, by connecting the fault to each overcurrent device with the panelboard connected to its rated voltage source. The source shall be capable of supplying specified panelboard short-circuit current or greater.
2. Testing of overcurrent devices only while individually mounted is not acceptable. Testing the bus structure by applying a fixed fault to the bus structure alone is not acceptable.
3. Mark each panelboard with its maximum short-circuit current rating at the supply voltage.
4. Series rating of panelboards with devices outside of the panelboard enclosure are not permitted.

C. Enclosures: Flush- or surface-mounted as indicated, NEMA PB 1, Type 1, UL 50, galvanized steel.

1. Size: Where multiple-width or multiple-section panelboards are indicated or required, each cabinet shall be the same width and height.
2. Provide enclosure type listed on drawings:

a. Indoor Dry and Clean Locations: NEMA 250, Type 1
b. All other indoor and outdoor Locations: NEMA 250, Type 4X stainless steel.

D. Directory card: Inside panelboard door, mounted in transparent card holder or metal frame with transparent protective cover with information as indicated in Part 3, Identification. Circuit directory card shall be 6 mm (¼ inch) narrower than the interior width of the directory card holder or holder metal frame.

E. Provisions for future devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

F. Furnish each unit with a master nameplate, listing standard manufacturer information including voltage, ampacity, frequency, and short-circuit ratings; manufacturer's model and project designations.

2.3 CIRCUIT-BREAKER PANELBOARDS

A. Factory-assembled complete with breakers.

B. Cabinets and fronts: Minimum 508 mm (20 inches) wide, wiring gutter space in accordance with UL 67, with minimum 101 mm (four inch) width on every side.

1. Cabinet front.

a. Nema 1 enclosures: Door-in-door construction, one or more latches as required for size, with outer door covering the gutter.
b. NEMA 4X enclosures: as directed by manufacturer.

2. Door: Required for sizes up to and including 600 amperes.

a. Lock: Flush, cylinder tumbler type, with catch and spring-loaded stainless steel door pull. All panelboards shall be keyed alike. Provide two keys per lock. Provide extra keys as required in "Extra Materials" in Part 1 above.
b. Hinges: Steel, completely concealed.

C. Circuit breakers: UL 489; voltage, continuous-current rating, and interrupting rating as indicated on the drawings or determined by the results of the Short-Circuit Analysis performed under Section 260573, whichever is greater.

1. Breakers shall be 1-, 2- or 3-pole, with an integral crossbar to ensure simultaneous opening of all poles in multipole circuit breakers.
2. Operating mechanism: Over center, trip-free, toggle-type with quick-make, quick-break action. Handles shall have on, off, and tripped positions.
3. Circuit breakers shall be able to be installed in the panelboard without requiring additional mounting hardware or disturbing adjacent units, bars, or branch circuit connections.
4. Where indicated on the drawings, provide shunt-trip main breakers, standard main breakers, or lugs.
5. Main and branch circuit breakers shall have device ampacity rating engraved on the front or side of each breaker handle. The breaker rating shall be clearly visible without removing panelboard cover.
6. Circuit breakers shall be rated for use with 75 deg C wire (conductor temperature rating).
7. 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 amperes and larger.

8. Electronic trip circuit breakers: RMS sensing; field-replaceable rating plug or field replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Measurement and Analysis Functions

        (1) Trip units shall have embedded measurement to provide real time metering. Metering accuracy by function shall be within 0.5% for current and voltage, and 1% for power and energy measurements. Metering accuracies shall be total measurement system, including CT and meter and shall be full scale over the range 10% to 120% of Ir. If not available at the circuit breaker, an external meter shall be provided for specified measurement and analysis functions.
        (2) Metering functions, at the point of measurement, shall calculate and display the imported and exported energy on each phase of the power system network. It shall calculate and display active, reactive and apparent energy per phase, as well as the total active, reactive and apparent energy.
        (3) Trip unit shall be able to display historic peak current demand per phase. Demand data shall be stored such that it is preserved through power outages.

9. Ground-fault circuit interrupter (GFCI) type circuit breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
10. Tandem breakers are not permitted.

D. Bussing assembly and temperature rise: Panelboard bus structure and main lugs or main circuit breaker shall have current ratings as shown on the panelboard schedule, established by heat rise tests conducted in accordance with UL 67.

    1. Conductor dimensions shall not be accepted in lieu of actual heat tests.
    2. Current-carrying parts of the bus structure shall tin-plated aluminum.
    3. Provide a separate copper ground bus with screw terminals for branch wiring and feed-through lugs.

E. Distribution panelboards: Distribution panelboard shall be capable of accepting up to 250-ampere branch circuit breakers, or as indicated on drawing wiring panel schedules. Current characteristics shall be as scheduled on the drawings.

F. Branch circuit panelboards: Panelboard shall be capable of accepting up to 100-ampere branch circuit breakers.

1. Branch circuit breakers serving telephone equipment, security equipment shall be provided with handle-blocking devices which shall prevent accidental operation but not prevent tripping.

2.4 SOURCE QUALITY CONTROL

A. With branch circuit breakers installed, short-circuit test panelboards as complete units, in accordance with requirements of UL 67.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely attach panelboards to the wall where indicated on the drawings. Install in accordance with NEMA PB 1.1 and manufacturer's written installation instructions.

1. Mounting height:

a. 1829 mm (72 inches) to top of panelboard.
b. Panelboards taller than 1829 mm (72 inches): Bottom edge no more than 102 mm (4 inches) above floor.
c. Top overcurrent device maximum height: No more than two meters (6 feet, 7 inches) above the floor or working platform.

B. Comply with applicable portions of NECA 407.

C. Frame and mount printed circuit directory indicating type and location of equipment on each circuit.

D. Wiring in gutters: Arrange conductors into groups, and bundle and wrap with wire ties.

E. Install filler plates in unused spaces.

F. Spare raceways: Where panelboards are recessed in wall construction, stub four 27-mm (1-inch) empty raceways from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

3.2 CONNECTIONS

A. Connect panelboards and components to wiring and to ground as indicated.

B. Shared neutral conductors shall not be permitted, except where indicated.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

A. Materials: Refer to Division 26 Section "Identification for Electrical Systems." Identify units, auxiliary devices, controls, and wiring. Identify equipment ratings.

B. Nameplates: Refer to Division 26 Section "Identification for Electrical Systems" for additional requirements. Provide identification nameplate for each panelboard and associated components located on front of assembly.

C. Identify field-installed wiring and components. Refer to Division 26 Section "Identification for Electrical Systems" for additional requirements.

D. Identify available fault current and calculation date. Refer to Division 26 Section "Overcurrent Protective Device Studies" for additional requirements.

E. Provide printed directory for each panelboard. Handwritten directories are not acceptable. Copying of panel schedules and descriptions on drawings is not acceptable. Circuit directory shall reflect final circuit installation. Include the following information:

1. Panelboard designation and room location.
2. Circuit breakers, size and number of poles.
3. Circuit or feeder description including destination room name(s) and number(s).
4. Clear description of type of load circuit serves.
5. Panelboard ratings: Main bus ampacity, main circuit breaker or main lug ampacity, AIC rating.
6. Incoming primary feeder size and source panelboard circuit designation.

F. Room names and numbers on the panelboard circuit directories shall match names and numbers used by the Owner. Note that room names and numbers on the drawings may not match the Owner's final room name and numbering scheme.

3.4 FIELD QUALITY CONTROL

A. Make insulation-resistance tests of each panelboard bus, component, and connecting supply, feeder, and control circuit.

B. Make continuity tests of each circuit.

C. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification for molded-case circuit breakers. Certify compliance with test parameters.

D. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 CLEANING

A. Clean interior and exterior of panelboards.

B. Refinish painted surfaces damaged during construction to match the rest of the panelboard.

END OF SECTION 262416

SECTION 262716 - CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Indoor enclosures.

B. Weatherproof enclosures.

1.2 SUBMITTALS

A. Product data: Each type of enclosure required for the project.

PART 2 - PRODUCTS

2.1 INDOOR ENCLOSURES

A. Type 1 in accordance with NEMA 250 and conforming to UL 57, of size required by NEC to fit equipment or as shown on the drawings.

B. Construction: Code grade galvanized steel.

2.2 WEATHERPROOF ENCLOSURES

A. Type 4X stainless steel accordance with NEMA 250 and conforming to UL 57, of size required by NEC to fit equipment or as shown on the drawings.

B. Construction: Fabricated of 14-gauge galvanized steel, with drip shield top and smooth, seam-free sides and back.

C. Doors: Double doors fabricated from 12-gauge galvanized steel, overlap type without center post.

1. Door gaskets: Neoprene, attached with oil-resistant adhesive and held in place with steel retaining strips.
2. Full-length piano hinges.
3. Locks: Keyed, with all keys alike. Provide two keys with each enclosure.

D. Provide steel channels in rear of cabinet for mounting metering equipment.

2.3 FINISHES

A. Satin gray enamel, inside and out.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely attach enclosure to wall, set on housekeeping pad, or hang on frame, as indicated.

3.2 LOCATIONS

A. Provide indoor type inside building and weatherproof type in exterior locations.

END OF SECTION 262716

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Receptacles.

B. Terminal blocks.

1.2 RELATED SECTIONS

A. Boxes: Section 260534.

B. Identification: Section 260553.

C. Toggle / snap switches for lighting: Section 260923.

1.3 REFERENCES

A. ANSI/NEMA WD 6: Wiring Devices - Dimensional Specifications.

B. NEMA WD 1: General Color Requirements for Wiring Devices.

C. UL 20: General-Use Snap Switches.

D. UL 498: Attachment Plugs and Receptacles.

E. UL 508: Standard for Industrial Control Equipment.

1.4 SUBMITTALS

A. Product data: Each type of device used in the project.

B. Field quality-control test reports.

PART 2 - PRODUCTS

2.1 RECEPTACLES

A. Acceptable manufacturers:

1. Arrow Hart/Eaton Wiring Devices
2. Hubbell/Bryant Electric
3. Legrand/Pass & Seymour (P&S)
4. Leviton Manufacturing Co.
5. Mulberry (for covers and faceplates)

B. Receptacles: NEMA 5-20R, 20-ampere rating, 125 volts AC, 2-pole, 2-wire plus ground, conforming to NEMA WD 1 and WD 6 configuration numbers, and UL 498.

1. Specification grade:

a. Ground-fault circuit-interrupter (GFCI) type, self-test, duplex:

(1) Basis of design: P&S 2097.

b. Ground-fault circuit-interrupter (GFCI) type for exterior and wet locations, duplex:

(1) Basis of design: P&S 2097TRWR, tamper-resistant, weather-resistant.

C. Device colors:

1. Normal power receptacles: White.
2. Generator power receptacles: Red.

D. Device covers:

1. Wet-location, weatherproof in-use cover, single-gang, extra-duty:

a. Basis of design: P&S WIUCAST1, while-in-use, cast aluminum, gray.

2. Wet-location, weatherproof WHEN NOT IN USE cover, single gang:

a. Basis of design:

(1) Vertical orientation: P&S CA26-GV
(2) Horizontal orientation: P&S CA26-GH

2.2 TERMINAL BLOCKS

A. Terminal blocks: Screw-terminal type, size as required by NFPA 70, NEMA 250 Type 1 enclosure with hinged cover.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices in complete compliance with the manufacturer's recommendations.

B. Arrangement of devices: Unless otherwise indicated, mount flush with long dimension vertical. Group adjacent devices under single multi-gang wall plates.

C. Receptacles:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
2. Verify that receptacles for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

D. Wall plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard wall plates do not fit flush or do not cover rough wall opening.

3.2 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify receptacles with panelboard identification and circuit number. Indoors, use self-adhesive labeling. Outdoors, use durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and inspections:

1. After installing devices and after electrical circuitry has been energized, test for compliance with requirements.
2. Receptacles:

a. Insert and remove test plug to verify that device is securely mounted.
b. Verify polarity of hot and neutral pins.
c. Measure line voltage.

d. Measure grounding circuit continuity; impedance shall be not greater than 2 ohms.

C. Correct malfunctioning devices on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new devices and retest.

D. Report results of tests and inspections in writing.

END OF SECTION 262726

SECTION 262800 - ENCLOSED CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Enclosed switches (disconnects/safety switches).

1.2 RELATED SECTIONS

A. Fuses: Section 262813.

B. Overcurrent protective device study: Section 260573.

1.3 REFERENCES

A. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. UL 98: Enclosed and Dead-Front Switches.

1.4 SUBMITTALS

A. Product data: Each type of enclosed switch.

1.5 QUALITY ASSURANCE

A. Comply with the following standards:

1. NEMA KS 1 for enclosed switches.
2. UL 98.
3. UL 198E.

B. UL label and local testing (if required): As specified in Section 260500, Common Work Results for Electrical.

PART 2 - PRODUCTS

2.1 ENCLOSED SWITCHES (DISCONNECTS/SAFETY SWITCHES)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corporation.
2. General Electric Company.
3. Schneider Electric; Square D products.
4. Siemens Industry, Inc.

B. Properly size switches for number of poles and provide fused or non-fused as required for project conditions and to meet NFPA 70 requirements.

C. Fuse contacts and quick-make/quick-break jaws shall ensure positive contacts with reinforcing spring clips or other approved means.

D. Switches shall be front-operated.

E. Current-carrying parts: Plated copper.

F. Hinges: Noncurrent-carrying.

G. Switches shall be lockable in either open or closed position.

H. Type:

1. Nonfused switches: General-duty type.
2. Fused switches: Heavy-duty type.

I. Enclosures: Indoors NEMA 250 Type 1; outdoors and in barns Type 4X stainless steel with raintight hubs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed switches where indicated and as required for motor outlets, transformers, and other equipment.

B. Securely attach and properly connect enclosed switches.

C. Provide an enclosed switch for each motor, as required by NFPA 70, except where it is provided in a panelboard within sight and easy reach of the motor, and provide wiring and connections from source. Enclosed switches shall be fused where protection is required or indicated on drawings and unfused elsewhere.

END OF SECTION 262800

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fuses.

1.2 RELATED SECTIONS

A. Enclosed switches: Section 262800.

1.3 REFERENCES

A. UL 198E: Class R fuses.

B. UL 198C: High-Interrupting-Capacity Fuses, Current Limiting Types.

1.4 SUBMITTALS

A. Product data: Each type of fuse.

B. Published data on fuses shall include time/current curves, peak-let-through curves and I^2t melting and clearing curves.

1.5 QUALITY ASSURANCE

A. Comply with UL 198C, Class L fuses, also Classes G and J.

B. UL label and local testing (if required): As specified in Section 260500, Common Work Results for Electrical.

1.6 EXTRA MATERIALS

A. Furnish three spare fuses for each type and size of fuse in the work.

PART 2 - PRODUCTS

2.1 FUSES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corporation; Bussmann
2. Littelfuse, Inc.
3. Mersen

B. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

C. Fuses 0-600 amps for 600 V or 250 V, UL labeled Class RK5 with time delay, with a minimum short-circuit interrupting capacity of 200,000 rms symmetrical amperes, and shall carry 500 percent of rating for a minimum of 10 seconds (8 seconds for sizes 30 amperes and lower).

1. Fuses for disconnecting switches for packaged HVAC equipment: Size and type recommended by the equipment manufacturer and as required for equipment to meet UL rating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses where indicated and as required for motor outlets or other equipment.

END OF SECTION 262813

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Luminaires, including LED light engines, LED drivers, and accessories.

1.2 RELATED SECTIONS

A. Commissioning requirements: Divisions 01 and 23.

B. Occupancy sensors: Section 260923.

1.3 SUBMITTALS

A. Product data: For each type of luminaire indicated, arranged in order of luminaire designation. Include data on features, accessories, and the following:

1. Dimensions of luminaires, photometrics and efficiency, wattage, reflectors, glassware, voltage, suspension, and appurtenances.
2. Certified results of laboratory tests for luminaires and lamps for photometric performance.
3. LED drivers.
4. Lumen output, rated color temperature, and manufacturer's LED binning procedures.

B. Maintenance data: For luminaires to include in maintenance manuals specified in Division 01.

C. Warranties: Special warranties specified in this section.

1.4 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 260500, Common Work Results for Electrical.

B. Luminaires and accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

C. Comply with NFPA 70.

D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

A. Luminaires, mounting hardware, and trim: Coordinate layout and installation of luminaires with ceiling system and other construction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver glassware in their original cartons, clearly labeled.

1.7 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor's and subcontractors' responsibilities are described in Divisions 01 and 23 for Commissioning Requirements.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-design products: Luminaires indicated in the Luminaire Schedule on the drawings are the basis of design of the project.

1. Subject to compliance with requirements, provide the scheduled products. Unnamed products will only be considered and approved according to Bidding and Contracting requirements and Division 01 requirements for substitutions.

B. Subject to compliance with requirements, provide products by one of the following:

1. Drivers:

a. Philips/Advance
b. Osram Sylvania
c. Universal Lighting Technologies
d. Lutron
e. EldoLED

C. Subject to compliance with requirements, provide products by one of the following:

1. Lamps:

a. General Electric
b. Osram Sylvania
c. Philips
d. Venture

2.2 LUMINAIRES, GENERAL

A. Luminaires shall comply with UL 1598 and be complete with casings, fittings, holders, shades, glassware, lamps, and appurtenances, wired and completely assembled.

B. Metal parts: Free from burrs, sharp corners, and edges.

C. Sheet metal components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, frames, and other internal access: Smoothly operating, free from light leakage under operating conditions, and arranged to permit access without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during access and when secured in operating position.

E. Metal finishes: Painted after luminaire fabrication.

F. Reflecting surfaces: 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 metalized film: 90 percent.

G. Lenses, diffusers, and covers: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated, exactly as scheduled or specified in optical details and lighting characteristics.

1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
2. Lens thickness: 3 mm (0.125 inch minimum, unless greater thickness is indicated.

2.3 LED DRIVERS

A. Driver shall operate from a 120-volt or 277-volt, 60-Hz input power source and be suitable for outputting power to 12-volt or 24-volt LED lamp sources, as required.

B. Drivers, where specified, shall be capable of being dimmed. Dimmable drivers shall be controlled by a Class 2 low-voltage 0-10VDC controller unless otherwise indicated.

C. Performance Criteria:

1. Driver shall have a Class A sound rating.
2. Driver shall have a power factor (PF) greater than 0.90.
3. Driver shall have Total Harmonic Distortion (THD) of input current equal to or less than 20 percent.

D. Driver shall meet FCC and Title 47 CFR regulations for EMI/RFI.

E. Driver shall comply with ANSI C62.41 Class A requirements for transient protection.

2.4 LED LIGHT ENGINES

A. The LED manufacturer shall provide the quantity and wattage of LEDs required to achieve the defined lighting output set forth by the luminaire manufacturer.

B. LED light engines shall be integrated into an engineered package for the specific luminaire application, including heat dissipation components.

C. Color temperature: As specified in luminaire schedule, with a tolerance of plus or minus 100^{O}K and within a range of three macadam ellipses. Noticeable color temperature variation between adjacent luminaires shall be considered a failure to meet these specifications and shall be replaced at no cost to the owner.

D. Minimum performance characteristics:

1. Life: Minimum lumen maintenance of L70 at 50,000 hours, as defined by IES LM-80.
2. Lumen output: Based on absolute photometry, lumens (total luminous flux exiting the physical luminaire), as specified on contract drawings and schedules.
3. Color rendering index: Rated at 80 or higher.

2.5 LUMINAIRE SUPPORT COMPONENTS

A. Comply with Section 260500, Common Work Results for Electrical, for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Rod hangers: 5-mm (3/16-inch) minimum diameter, cadmium-plated, threaded steel rod.

2.6 FINISHES

A. Luminaires: Manufacturer's standard, unless otherwise indicated.

1. Paint finish: Applied after fabrication over corrosion-resistant treatment or primer, free of defects.
2. Metallic finish: Corrosion-resistant.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before ordering the luminaires, consult with the installer of the ceilings to ensure that the correct luminaire trim is supplied and installed. Provide the supports and accessories required for installation in each ceiling system.

B. Before ordering the luminaires, verify the specified voltage with the voltage shown on the drawings to ensure the correct voltage is supplied.

3.2 INSTALLATION

A. Furnish and install a complete luminaire for every outlet indicated on the drawings so that every outlet shall be properly provided with a suitable luminaire of type specified, of wattage indicated.

B. Luminaire wire shall bear UL label. Luminaire wiring for luminaires and branch circuit wiring luminaire channels shall be type THHN.

C. Each luminaire shall be completely equipped with lamps of the size, type, wattage and shape indicated and specified. Lamps shall be of the proper voltage for the facility.

D. Furnish luminaires in the quantities, sizes, and types indicated on drawings.

3.3 LUMINAIRE SUPPORT

A. Support from building structure: Provide fasteners appropriate to the supporting substrate, and wire, jack chain, or rods as specified for particular luminaire types below.

1. Provide channels bolted or welded between joists where required to obtain proper spacing for lighting supports.
2. Connections to joists or beams: Beam clamps. For wire supports, wrap wire securely around structural member.

3.4 CLEANING

A. Luminaires, used for temporary lighting during construction, shall be cleaned free of construction dirt to like-new condition, and re-lamped with the specified lamps.

END OF SECTION 265100

SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Luminaires

1.2 RELATED SECTIONS

A. Commissioning requirements: Divisions 01 and 23.

B. Raceways: Section 260533.

C. Wires and cables: Section 260519.

1.3 DEFINITIONS

A. Bracket: An attachment to a standard, on which a luminaire is carried.

B. Luminaire: A lighting device consisting of a light source together with its direct appurtenances, including globe, reflector, refractor, housing, and such support as is integral with the housing. The standard and the bracket are not part of the luminaire.

1.4 SUBMITTALS

A. Product data: Submit for each type of luminaire, pole and standard.

1. Type
2. Wattage
3. Voltage
4. Efficiency
5. Suspension
6. Glassware
7. Finished diameters
8. Mounting heights
9. Lamps
10. LED drivers
11. Appurtenances

B. Shop drawings shall show complete dimensions of complete assembled unit with accessories. Include wiring diagrams, showing clearly manufacturer-installed and field-installed wiring.

C. Samples: If contractor has selected luminaires not identical to scheduled luminaires, as permitted in Part 2 below as an option, COTR may require submittal of samples.

1. One complete luminaire of each approved type, except as otherwise instructed by COTR.
2. Install approved samples as work of the project, in locations as directed, as standards for all luminaires of the same type.
3. If substitute luminaires should be requested, submit samples as required.
4. For selection, manufacturer's complete line of colors and textures.

1.5 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 260500, Common Work Results for Electrical.

B. Comply with requirements for commissioning specified in Division 01.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver glassware and lamps in their original cartons, clearly labeled.

1.7 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor's and subcontractors' responsibilities are described in Divisions 01 and 23 for Commissioning Requirements.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-design products: Luminaires indicated in the Luminaire Schedule on the drawings are the basis of design of the project.

1. Subject to compliance with requirements, provide the scheduled products. Unnamed products will only be considered and approved according to bidding and Contracting requirements and Division 01 requirements for substitutions.

B. Subject to compliance with requirements, provide products by one of the following:

1. LED drivers:

a. EldoLED
b. Lutron
c. Osram Sylvania
d. Philips/Advance
e. Universal Lighting Technologies

2. Lamps:

a. General Electric
b. Osram Sylvania
c. Philips
d. Venture

2.2 EXTERIOR LUMINAIRES

A. Provide luminaires of sizes, types, and ratings scheduled, complete with, but not limited to, housings, drivers, light-emitting diodes, and wiring.

2.3 LED DRIVERS

A. Driver shall operate from a 120-volt, 60-Hz input power source and be suitable for outputting power to 12-volt or 24-volt LED lamp sources, as required.

B. Drivers, where specified, shall be capable of being dimmed. Dimmable drivers shall be controlled by a Class 2 low-voltage 0-10VDC controller.

C. Performance criteria:

1. Driver shall have a Class A sound rating.
2. Driver shall have a power factor (PF) greater than 0.90.
3. Driver shall have Total Harmonic Distortion (THD) of input current equal to or less than 20 percent.

D. Driver shall meet FCC and Title 47 CFR regulations for EMI/RFI.

E. Driver shall comply with ANSI C62.41 Class A requirements for transient protection.

2.4 LAMPS

A. Lamps, LED:

1. The LED manufacturer shall provide the quantity and wattage of LEDs required to achieve the defined lighting output set forth by the luminaire manufacturer.
2. LED lamps shall be integrated into an engineered package for the specific luminaire application, including heat dissipation components.
3. Color temperature: As specified in luminaire schedule, with a tolerance of plus or minus 100K and within a range of three macadam ellipses. Noticeable color temperature variations between adjacent luminaires shall be considered a failure to meet these specifications and shall be replaced at no cost to the Owner.
4. Minimum performance characteristics:

    a. Life: Minimum lumen maintenance of L70 at 50,000 hours, as defined by IES LM-80.
    b. Lumen output: Based on absolute photometry, lumens (total luminous flux exiting the physical luminaire), as specified on contract drawings and schedules.
    c. Color rendering index: Rated at 85 or higher.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install luminaires and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NFPA 70, NESC and NEMA standards, and with recognized industry practices.

3.2 ADJUSTING AND CLEANING

A. Aim adjustable luminaires and lamps in night test of system.

B. Clean luminaires of dirt and debris upon completion of installation.

C. Protect installed luminaires from damage during construction period.

3.3 DEMONSTRATION

A. Upon completion of installation of exterior luminaires, and associated electrical supply circuitry, apply electrical energy to circuitry to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION 265600

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SECTION 270101 - COMMUNICATIONS GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for communications work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

B. Division 01 includes sections specifying requirements for commissioning and construction waste management.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers.

B. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 27.

B. Visit the site and study aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of labor, equipment and materials, and the performance of operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for necessary signatures and paperwork, permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Owner.

E. Communications work of this project includes, as a brief general description, the following:

1. Removal of existing telecommunications wiring.
2. Disconnection of existing network equipment.

3. Installation of existing network equipment in new locations.
4. Providing communications outlets with cable back to head-end equipment.
5. The project includes commissioning under the direction of a Commissioning Agent (CxA).

F. See Division 01 for requirements related to commissioning, Owner's occupancy of the premises, limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 27 specifications.

B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for coordination and additional costs as specified in article "Substitutions" below for substitutions.

C. Products specified by reference standards or by description only: Any product meeting those standards or description.

D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance, and shall not be construed as limiting competition. Contractor may use products of any manufacturer, which meet the specifications.

E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 27 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project and of representative manufacturer. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. Equipment, construction and installation must meet requirements of Smithsonian Institution and federal governing codes.

C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

1. Furnish: Supply item
2. Install: Mount and connect item
3. Provide: Furnish and install

E. Materials and equipment shall be installed and completed in a first class and professional manner and in accordance with the best modern methods, practice and manufacturers' instructions. Any work which shall not present an orderly and neat or professional appearance shall be removed and replaced with satisfactory work when so directed in writing by the COTR.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall artisanry.

G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the COTR will determine sizes to be utilized.

H. In cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the COTR of said uncertainty, doubt, or conflict and obtain a decision as to the intent prior to initiating any work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the COTR and await a written decision.

B. Plan and coordinate work to proceed in an orderly and continuous manner without undue delay, and in conformance with the project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate communications work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of raceway, luminaires, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor's responsibility to bring this to the attention of the COTR prior to initiation of work. Correct improperly coordinated installation at no additional cost.

E. The Contractors' assistants shall include a competent communications supervisor, who shall be on the premises at all times to check, layout, coordinate and superintend the installation of work. The supervisor shall establish basic requirements relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers' and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of Shop Drawings and Product Data for every item of equipment. Shop drawings or product data will not be considered until Manufacturers' Lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor's name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.
3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.
4. Exclusively communications items furnished as items associated with mechanical items but not specifically described in the mechanical item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the mechanical item by identified specification paragraph.

5. Product data sheets shall be 215.9 mm by 279.4 mm (8.5 inches by 11 inches) cut sheets for operating and maintenance manual.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of owner's representative, and project type and size.

E. After the work is completed, submit required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the COTR prior to final acceptance of the work.

1.10 SPECIALIST

A. The term "Specialist" as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer's direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:

a. Contract Drawings.
b. Specifications.
c. Addenda.
d. Change Orders and other Modifications to the Contract.
e. Reviewed shop drawings, product data, and samples.

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:

    a. Manufacturer's name and product model and number.
    b. Product options, substitutions, or alternates utilized.
    c. Changes made by addenda and modifications.

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:

    a. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
    b. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
    c. Field changes of dimension and detail.
    d. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.
2. Prepare covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," and title of project.
3. Internally subdivide the contents with permanent page dividers, logically organized as described below.
4. Contents: Prepare a Table of Contents, with each product or system description identified.
5. Part 1: Directory, listing names, addresses, and telephone numbers of communications engineers; contractor; communications subcontractors; and major communications equipment suppliers.
6. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

    a. Significant design criteria.
    b. List of equipment.

c. Parts list for each component, including recommended spare parts list.
d. Operating instructions.
e. Maintenance instructions for equipment and systems.
f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

7. Part 3: Project documents and certificates, including the following:

a. Shop drawings and product data.
b. Photocopies of certificates.
c. Photocopies of warranties, guarantees, and bonds.
d. Test reports: Copies of the results of tests required under sections of specifications.

8. Submit one copy in final form 15 days prior to final inspection. This copy will be returned after final inspection, with COTR comments. Revise content of documents as required prior to final submittal.
9. Submit final revised copy within ten days after final inspection.
10. Submit operation and maintenance data in electronic format.

1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The communications, building, fire, and safety codes of the Smithsonian Institution in which the work is being performed.
2. The National Electric Code, NFPA 70 (NEC).
3. The National Fire Protection Association Code. (NFPA)
4. International Building Code (IBC).
5. International Energy Conservation, Fire, and Communications Codes (ICC).

1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply.

1. Federal Specifications (FS)
2. American National Standards Institute (ANSI)
3. American Society for Testing and Materials (ASTM)
4. International Code Council (ICC)
5. Institute of Electrical and Electronics Engineers (IEEE)
6. National Electrical Code (NEC) (NFPA 70)
7. National Electrical Manufacturer's Association (NEMA)
8. National Fire Protection Association (NFPA)
9. The Occupational Safety and Health Act (OSHA)
10. Underwriters Laboratory Inc. (UL)
11. American Association of State Highway and Transportation Officials (AASHTO)
12. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
13. Illuminating Engineering Society of North America (IESNA)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for contents within these areas. Provide security measures necessary for this area.

B. Area shall be maintained and shall be returned to original condition at the completion of the project.

C. Store communications construction materials such as cables, raceways and boxes, devices, and equipment in buildings, enclosed trailers, or portable enclosed warehouses.

1. Materials and products subject to damage from moisture: Store in dry locations. If necessary, protect with protective wraps or covers.
2. Plastics and other materials and products subject to damage from heat or cold: Store at manufacturer's recommended temperatures.
3. Plastics and other materials and products subject to damage from sunlight: Protect from sunlight.

D. Communications equipment such as network switches, fiber-copper media converters, and patch panels stored before installation and installed during construction: Provide clean, dry locations at manufacturer's recommended temperatures, and cover or wrap if required to protect from incidental damage.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.
5. Protect areas occupied by Owner's personnel or equipment.
6. Seal off return air registers and other mechanical systems to prevent dust from entering.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair damage or soiling to the complete satisfaction of the COTR; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, at no addition to the Contract sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer's recommended temperatures.

E. Protect communications materials and products from weather events and accidents of construction.

F. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.16 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.17 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in "Cutting and Patching" below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the COTR in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.18 WARRANTY

A. Work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties as specified in individual sections.

B. During the correction period, the Contractor shall begin correcting any work found to be not in accordance with the requirements of the Contract Documents within 4-hours of receiving written notice from the Owner. Provide detailed schedule for completion of work within 24-hours of receiving written notice from the Owner and revise schedule based on any Owner comments generated. Except as otherwise required in General Conditions and Division 01, the correction period is one year after the date of substantial

completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

1. Service reports for warranty work shall be provided to the Owner.

C. When use of the permanent equipment has been permitted for temporary services during construction of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers' standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.19 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor's and subcontractors' responsibilities are described in Division 01.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of raceways. Close superfluous openings and remove debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the COTR.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.3 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or COTR finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, COTR shall be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

3.4 COMMISSIONING

A. Comply with requirements of 'Commissioning" in Part 1 above.

END OF SECTION 270101

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SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to work of more than one section of Division 27.

B. Basic materials and equipment required for communications work.

C. Date sensitive equipment.

D. Communications identification.

E. Operating instructions.

F. Testing wiring systems.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 270101.

B. Operation and Maintenance Manuals: Division 01 and Section 270101.

C. Painting: Division 09.

D. Construction waste management: Division 01.

E. Commissioning requirements: Division 01 and Division 23.

F. Demolition: Section 260504.

G. Raceways: Section 260533.

1.3 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A national recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

1.4 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed on the basis of using the particular manufacturers' products specified and scheduled on the drawings.

B. Products of other manufacturers that are listed under the article "Acceptable Manufacturers," or permitted as "equal," are permitted provided:

1. Product shall meet the specifications.
2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that make their use impractical or cause functional fit, access, or connection problems.

D. The contract drawings are generally diagrammatic, and do not indicate all fittings or offsets in raceway or all pull boxes, access panels, or other specialties required.

1. Install raceway exposed to view parallel with the lines of the building and as close to walls, columns, and ceilings as may be practical, maintaining adequate clearance for access at parts requiring servicing.
2. Install raceway a sufficient distance from other work to permit a clearance of not less than 15 mm (0.5 inch) between its finished covering and adjacent work.
3. No raceway shall be run below the head of a window or door.
4. Pull boxes and other appurtenances which require operation or maintenance shall be easily accessible. Do not cut or form handholes for operation or maintenance of appliances through walls or ceilings.

1.5 SUBMITTALS

A. Test reports: Show that tests specified in Part 3 below demonstrate the specified results.

1.6 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the electrical, building, fire, and safety codes and regulations of the state, county, or city in which the work is performed.

B. Communications equipment, materials and devices provided or installed as work of Division 27 shall bear UL label, or, if UL label is not available, the item shall be tested and labeled by a qualified testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70. Provide testing, if required, without addition to the contract sum.

C. VOC content: Field-applied adhesives and sealants, limits per South Coast Air Quality Management District (SCAQMD), Rule No. 1168.

D. Products shall contain no urea-formaldehyde content.

1.7 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractors' and subcontractors' responsibilities are described in Division 01.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Telephone, data, and communications equipment backing panels: Plywood, AWPA Use Category 5B (marine), B-B, fire-retardant, in thickness indicated, not less than 19 mm (0.75 inch) nominal.

B. Nameplates: Laminated plastic, engraved, white letters on black background, except where other colors are noted or specified.

1. Size: Minimum 19 mm (0.75 inch) by 64 mm (2.5 inches).
2. Letter size: Minimum height 5 mm (0.1875 inch).
3. Fasteners: Vandalproof brass screws or rivets.

2.2 DATE-SENSITIVE EQUIPMENT

A. Date-sensitive equipment: Systems, equipment, or components which use or process date and time data in order to perform their functions.

B. Each item of date-sensitive equipment used in the project shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Comply with Section 260504 Electrical Demolition.

3.2 INSTALLATION OF PRODUCTS AND EQUIPMENT

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify COTR if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

B. Install plywood backing panels with finished face exposed.

3.3 IDENTIFICATION

A. Items to be identified include, but are not limited to:

1. Voice and data communications systems and devices.
2. Video systems and devices.
3. Sound systems and devices.
4. Wire management equipment.

B. Identify function, equipment services, and area served.

3.4 TESTS

A. During the progress of the work and after completion, test the communications cabling and wiring systems.

B. Results of the tests shall show that the wiring meets the requirements of this specification. Should any test indicate defect in materials or installation, immediately repair, or replace with new, the faulty work, and retest the affected portions of the work.

C. Furnish equipment and instruments necessary for testing.

D. Tests shall demonstrate the following:

1. Power, control, and system circuits are continuous and free from short circuits.
2. Circuits are free from unspecified grounds.
3. Circuits are properly connected in accordance with the applicable wiring diagrams.
4. Circuits are operable.

E. Immediately repair defects and retest until systems are operating correctly.

F. Submit test reports.

3.5 OPERATING INSTRUCTIONS

A. Furnish the necessary technicians, skilled workers, and helpers to operate the communications systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Owner or designated personnel in operation, maintenance, and adjustment of systems and equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions for use by instructors and Owner personnel.

E. Schedule the general and specialized instruction periods for a time agreed upon by the COTR.

END OF SECTION 270500

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SECTION 271500 - VOICE AND DATA COMMUNICATIONS CABLING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wire, cable, connecting devices, installation, and testing for wiring systems to be used as signal pathways for voice and high-speed data transmission.

B. Many of the requirements of this section apply to the main “Renew Cheetah Conservation Station” project and are included here for information only.

1.2 DEFINITIONS

A. BICSI: Building Industry Consulting Service International

B. EMI: Electromagnetic interference.

C. IDC: Insulation displacement connector.

D. LAN: Local area network.

E. OCIO: Smithsonian’s Office of the Chief Information Officer.

F. PVC: Polyvinyl chloride.

G. RCDD: Registered Communication Distribution Designer

H. STP: Shielded twisted pair.

I. UTP: Unshielded twisted pair.

1.3 SUBMITTALS

A. Product data: Include data on features, ratings, and performance for each component specified.

B. Shop drawings: Include dimensioned plan and elevation views of each individual component. Show equipment assemblies, method of field assembly, workspace requirements, and access for cable connections.

1. System labeling schedules, including electronic copy of labeling schedules, as specified in Part 3, in software and format selected by Smithsonian's Office of the Chief Information Officer.
2. Wiring diagrams. Show typical wiring schematics including the following:

    a. Backbone Riser Diagram
    b. Workstation outlets, jacks, and jack assemblies.
    c. Patch cords.
    d. Patch panels.
    e. Fiber-optic boxes.

C. Cable Administration Drawings: As specified in Part 3.

D. Optical fiber cable testing plan.

E. Source quality-control reports.

F. Product certificates: For each type of cable, connector, and terminal equipment, signed by product manufacturer.

G. Qualification data: For installer.

H. Field quality-control test reports.

I. Operation and maintenance data: For voice and data communication cabling to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer qualifications: Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of BICSI certified Technician or Level 2 Installer. Whenever fiber optic cable work is performed at the project site, this supervisor shall be present.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing. System installer must have on staff a registered communication distribution designer certified by Building Industry Consulting Service International.

B. Source limitations:

1. Obtain all twisted-pair copper cables through one source from a single manufacturer.
2. Obtain all twisted-pair copper cable hardware through one source from a single manufacturer.
3. Obtain optical fiber cable hardware from single source and from single manufacturer. Provide cable hardware from same manufacturer as optic fiber cable.

C. 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.

D. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of voice and data communication cabling with Smithsonian's Office of the Chief Information Officer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Test fiber optic cables upon receipt at project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in indoor 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.

1.8 EXTRA MATERIALS

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

1. Cable: 76 meters (250 feet) of each size and type used for project. Furnish on reels.

2. Patch-panel units: One of each type for every six installed, but no less than one.
3. Connecting blocks: One of each type for every 25 installed, but no less than one.
4. Outlet assemblies: One of each type for every 25 installed, but no less than one.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Copper cable:

   a. Belden Inc.; Electronics Division.
   b. Lucent Technologies; Global Service Provider.
   c. Mohawk/CDT; a division of Cable Design Technologies.
   d. Superior Essex; Superior Telecommunications Inc.

2. Copper cable terminal and connector components and distribution racks:

   a. AMP Incorporated; a Tyco International Ltd. Company.
   b. Hubbell Premise Wiring.
   c. Leviton Telecom.
   d. Lucent Technologies; Global Service Provider.

3. Fiber optic cable, terminal and connector components and distribution racks:

   a. Belden Inc.; Electronics Division.
   b. Corning Cable Systems.

2.2 SYSTEM REQUIREMENTS

A. General: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.

B. Expansion capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in cross-connect and patch panels, and terminal strips to accommodate 20 percent future increase in active workstations.

C. General Performance: Fiber optic backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

D. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 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: 50 or less.

2.3 MOUNTING ELEMENTS

A. Raceways and boxes: Comply with Sections 260533 and 260534.

B. Backboards: 19-mm (0.75-inch), Category B-B, marine grade, fire-retardant-treated plywood.

2.4 TWISTED-PAIR CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

A. Cables: Listed as complying with Category 6 of TIA/EIA-568-D.

B. Conductors: Solid copper.

C. UTP cable: Comply with TIA/EIA-568-D. Four, thermoplastic-insulated, individually twisted pairs of conductors; No. 24 AWG, color-coded; enclosed in PVC jacket.

D. UTP plenum cable: Listed for use in air-handling spaces. Features are as specified for cables, conductors, except materials are modified as required for listing.

E. UTP cable connecting hardware: Comply with TIA/EIA-568-D. IDC type, using modules designed for punch-down caps or tools.

1. IDC terminal block modules: Integral with connector bodies, including plugs and jacks where indicated.
2. IDC connecting hardware: Consistent throughout project.

F. 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 conductor group of indicated cables, plus spares and blank positions adequate to satisfy specified expansion criteria.
2. Mounting: Backboard.

G. Jacks and jack assemblies for UTP cable: Modular, color-coded, RJ-45 receptacle units with integral IDC-type terminals. Use keyed jacks for data service. Jacks shall be white.

H. UTP patch cords: Four-pair cables in 1200-mm (48-inch) lengths, terminated with RJ-45 plug at each end. Use keyed plugs for data service.

I. Workstation outlets:

1. Faceplate: High-impact plastic; white.
2. Mounting: Flush, unless otherwise indicated.
3. Legend: As indicated on drawings, by silk-screening or engraving.

2.5 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, PLENUM RATED, INDOOR MULTIMODE OPTICAL FIBER CABLE (OM4), 6-STRAND, TIGHT BUFFER

A. Acceptable Manufacturers

1. Belden
2. Corning Cable Systems

B. Basis of design: Belden FD4D006P9, Corning 006T88-31190-29 or approved equivalent.

C. Minimum Required Features and Specifications

1. Standards:

a. Comply with ICEA S-83-596 for mechanical properties.
b. Comply with TIA-568-C.3 for performance specifications.
c. Comply with TIA-492AAAD for detailed specifications.

2. Maximum Attenuation: 3.00 dB/km at 850 nm; 1.0 dB/km at 1300 nm.
3. Minimum Overfilled Modal Bandwidth-length Product: 3500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
4. Minimum Effective Modal Bandwidth-length Product: 4700 MHz-km at 850 nm.
5. Jacket:

a. Jacket Color: Black or Aqua
b. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

6. 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. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

2.6 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, RISER RATED, INDOOR-OUTDOOR, MULTIMODE OPTICAL FIBER CABLE (OM4), 6-STRAND, LOOSE TUBE

A. Acceptable Manufacturers

1. Belden
2. Corning Cable Systems

B. Basis of design: Belden FD4L006P9, Corning 006TSP-T4190D20, or approved equivalent.

C. Minimum Required Features and Specifications

1. Standards:

    a. Comply with ICEA S-83-596 for mechanical properties.
    b. Comply with TIA-568-C.3 for performance specifications.
    c. Comply with TIA-492AAAD for detailed specifications.

2. Maximum Attenuation: 3.00 dB/km at 850 nm; 1.0 dB/km at 1300 nm.
3. Minimum Overfilled Modal Bandwidth-length Product: 3500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
4. Minimum Effective Modal Bandwidth-length Product: 4700 MHz-km at 850 nm.
5. Jacket:

    a. Jacket Color: Black or Aqua
    b. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
    c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

6. 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. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

2.7 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, PLENUM RATED, INDOOR-OUTDOOR MULTIMODE OPTICAL FIBER CABLE (OM4), 6-STRAND, LOOSE TUBE, DOUBLE-JACKET, ARMORED

A. Acceptable Manufacturers

1. Belden
2. Corning Cable Systems

B. Basis of design: Belden FD4H0065F, Corning (Contact manufacturer at time of order), or approved equivalent.

C. Minimum Required Features and Specifications

1. Standards:

   a. Comply with ICEA S-83-596 for mechanical properties.
   b. Comply with TIA-568-C.3 for performance specifications.
   c. Comply with TIA-492AAAD for detailed specifications.

2. Maximum Attenuation: 3.00 dB/km at 850 nm; 1.0 dB/km at 1300 nm.
3. Minimum Overfilled Modal Bandwidth-length Product: 3500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
4. Minimum Effective Modal Bandwidth-length Product: 4700 MHz-km at 850 nm.
5. Jacket:

   a. Jacket Color: Black or Aqua
   b. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
   c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).
   d. Armored: Corrugated Steel Tape

6. 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:

   b. Riser Rated, Conductive: Type OFCR, complying with NFPA 262.

2.8 9/125 MICROMETER SINGLE-MODE (OS2), RISER RATED, INDOOR-OUTDOOR OPTICAL FIBER CABLE, 6-STRAND, LOOSE TUBE, DOUBLE-JACKET, ARMORED

A. Acceptable Manufacturers

1. Belden
2. Corning Cable Systems

B. Basis of design: Belden FDSH0065F, Corning (Contact manufacturer at time of order), or approved equivalent.

C. Minimum Required Features and Specifications

1. 9/125-micrometer, 6 fibers, conductive loose tube, optical fiber cable (OS2).
2. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.
3. Standards:

   a. Comply with ICEA S-104-696 for mechanical properties.
   b. Comply with TIA-568-C.3 for performance specifications.
   c. Comply with TIA-492CAAB for detailed specifications.

4. Jacket:

   a. Jacket Color: Black or Aqua
   b. Armored: Corrugated Steel Tape Cable. Cordage, jacket, fiber, unit, and group color shall be according to TIA-591-D.
   c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

5. 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. Riser Rated, Conductive: Type OFCR, complying with NFPA 262.

2.9 FIBER-OPTIC CONNECTORS AND TERMINAL EQUIPMENT

A. Standards:

1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.
2. Comply with TIA-568-C.3.

B. Closet Connector Housing

1. Acceptable Manufacturers

    a. Corning
    b. Belden

2. Corning CCH-04U and CCH-01U; Belden AX105565 and AX105563, or approved equivalents
3. Minimum Required Features and Specifications

    a. Holds 12 CCH and 2 CCH connector panels
    b. Four (4) rack units high or
    c. One (1) rack unit high
    d. Flush mount in 19” rack
    e. Front and rear access

4. Additional Required Options / Parts

    a. Corning Closet Connector Housing Panel CCH-CP12-A9 or approved equivalent

        (1) Holds 12 fibers, Single Mode (OS2)
        (2) LC duplex connectors

    b. Corning Closet Connector Housing Panel CCH-CP24-E4 or approved equivalent

        (1) Holds 24 fibers, Multimode (OM/4)
        (2) LC duplex connectors

C. Fiber Patch Panel (FPP) Housing (Surface Mount)

1. Acceptable Manufacturers

    a. Corning

2. Corning WCH-04P is the basis of design.
3. Minimum Required Features and Specifications

    a. Holds 4 CCH connector panels
    b. Surface/wall mountable

4. Additional Required Options / Parts – Quantity based on configuration

a. Corning Closet Connector Housing Panel CCH-CP12-E4 or approved equivalent

(1) Holds up to 12 fibers, 50 micron, multimode (OM/4)
(2) LC duplex connectors

b. Corning Closet Connector Housing Panel CCH-CP12-A9 or approved equivalent

(1) Holds up to 12 fibers, single mode (OS2)
(2) LC duplex connectors

c. CCH Strain relief brackets CCH1-STRN-INT or approved equivalent

D. Fiber Single Panel (FSP) Housing

1. Acceptable Manufacturers

a. Corning

2. Corning SPH-01P is the basis of design.
3. Minimum Required Features and Specifications

a. Holds 1 CCH connector panel
b. Surface/wall mountable
c. Optimized for box-in-a-box applications

4. Additional Required Options / Parts

a. Corning Closet Connector Housing Panel CCH-CP12-E4 or approved equivalent

(1) Holds 12 fibers, 50 micron, multimode (OM/4)
(2) LC duplex connectors

b. DIN rail bracket SPH-DIN-KIT or approved equivalent
c. Jumper protection bracket SPH-01P-JMPR-BKT or approved equivalent

E. 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.

F. Patch Cords: Factory-made, dual-fiber cables in 36 inch (900 mm) lengths.

G. Connector Type: Type LC duplex complying with TIA-604-10-B.

H. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.

I. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.
4. Designed to snap-in to a patch panel or faceplate.

2.10 IDENTIFICATION PRODUCTS

A. Comply with Division 27 Section "Common Work Results for Communications" and the following:

1. Cable labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.
2. 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.

2.11 SOURCE QUALITY CONTROL

A. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.

B. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION OF MEDIA

A. The fiber optic backbone serving the Cheetah Conservation Station originates in the Visitor Center. The backbone is accessible in the CCS IT closet. From there the backbone goes to a weatherproof enclosure on the side of Barn B4 (the Kudu Barn). From there the backbone goes to the Panda exhibit. Portions of this backbone will be removed and replaced under this project. The main “Renew Cheetah Conservation Station Project”, Contractor will provide temporary backbone cable as needed to keep the rest of the Zoo’s network operational. Protect the existing-to-remain portions fiber optic backbone.

B. Horizontal cable for data service: Use UTP Category 6 cable for runs between media converters and wireless access points.

C. Horizontal cable for voice service: Use UTP Category 6 cable for runs between wiring closets and workstation outlets.

D. Horizontal cable for video service: Use UTP Category 6 cable for runs between wiring closets and video outlets.

3.3 INSTALLATION

A. Comply with requirements in TIA/EIA-568-D and TIA/EIA-569-E.

B. Wiring method: Install wiring and optical fiber in raceway except within equipment rooms, wiring closets, consoles, cabinets, desks, and counters and except in accessible ceiling spaces. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings.

C. Install cables using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.

D. Install cables without damaging conductors, shield, or jacket.

E. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.

F. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

1. Pull cables simultaneously if more than one is being installed in same raceway.
2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
3. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage media or raceway.

G. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.

H. Secure and support cables at intervals not exceeding 760 mm (30 inches) and not more than 150 mm (6 inches) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

I. Wiring in closets and enclosures: Provide conductors of adequate length. Train conductors to terminal points with no excess. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

J. Separation of wires: Comply with TIA/EIA-569-E rules for separating unshielded copper voice and data communication cabling from potential EMI sources, including electrical power lines and equipment.

K. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels.

L. Use splice and tap connectors compatible with media types.

M. Optical Fiber Backbone Cables

1. Comply with NECA 1, NECA 301, and NECA/BICSI 568.
2. General Requirements for Optical Fiber Cabling Installation:

a. Comply with TIA-568-C.1 and TIA-568-C.3.
b. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
c. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

d. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
e. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
f. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
g. 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.
h. Cold-Weather Installation: Bring cable to room temperature before unreeling. Heat lamps shall not be used for heating.
i. In the communications rooms, provide a 10 foot (3 m) long service loop on each end of cable.
j. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
k. Terminate cable on connecting hardware that is rack or cabinet mounted.
l. Placement of Cable into Conduit Risers: Provide conduit risers as indicated on the plans. Use grips and/or other hanger devices to support the vertical drop of cable and prevent any possible kinking of the cable after installation.
m. Minimum Bend Radius: For static storage, do not bend the cable at any location to less than ten times the outside diameter of the cable or as recommended by the manufacturer. During installation, the cable shall not be bent at any location to less than twenty times the outside diameter of the cable or as recommended by the manufacturer.

3. Open-Cable Installation:

a. Install cabling with horizontal and vertical cable guides in communications spaces with terminating hardware and interconnection equipment.
b. Do not run cable through structural members or in contact with pipes, ducts, or other potentially damaging items.

4. Group connecting hardware for cables into separate logical fields.

3.4 GROUNDING

A. Comply with Section 260526, Grounding and Bonding.

B. Ground equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

3.5 INSTALLATION IN EQUIPMENT ROOMS AND WIRING CLOSETS

A. Install plywood backboards on walls of equipment rooms and wiring closets where indicated.

B. Mount patch panels, terminal strips, and other connecting hardware on backboards, unless otherwise indicated.

C. Group connecting hardware for cables into separate logical fields.

D. Use patch panels to terminate cables entering the space, unless otherwise indicated.

3.6 IDENTIFICATION

A. In addition to requirements in this Article, comply with applicable requirements in Section 270500, Common Work Results for Communications, and TIA/EIA-606.

B. System: Use a unique, three-syllable, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with same designation. Use logical and systematic designations for facility's architectural arrangement.

1. First syllable identifies and locates equipment room or wiring closet where cables originate.
2. Second syllable identifies and locates cross-connect- or patch-panel field in which cables terminate.
3. Third syllable designates type of media (copper or fiber) and position occupied by cable pairs or fibers in field.

C. Workstation: Label cables within outlet boxes.

D. Distribution racks and frames: Label each unit and field within that unit.

E. 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. Cables, general: Label each cable within 100 mm (4 inches) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

G. Exposed cables and cables in wireways: Label each cable intervals not exceeding 4.5 meters (15 feet).

H. Cable schedule: Post in 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, in software and format selected by Smithsonian's Office of the Chief Information Officer.

I. Cable administration drawings: Show building floor plans with cable 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. Follow convention of TIA/EIA-606. Furnish electronic record of all drawings, in software and format selected by the Smithsonian's Office of the Chief Information Officer.

3.7 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.
2. Copper cable procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 6 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-TSB67, "Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems." Link performance for UTP cables must meet minimum criteria of TIA/EIA-568-D.
3. Fiber-optic cable procedures:

    a. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color- coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
    b. Visually inspect cable placement, cable termination, equipment and patch cords, and labeling of all components.
    c. Optical Fiber Cable Tests:

(1) Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
(2) Link End-to-End Attenuation Tests:

1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, 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 those calculated according to equation in TIA-568-C.1.

(3) OTDR Test: Perform optical time domain reflectometer test in the 800 to 1300 nanometers wavelength band on the fiber optic cable after it is installed. Calibrate he optical time domain reflectometer to show anomalies of zero point two (0.2) dB as a minimum. If the optical time domain reflectometer test results are unsatisfactory, replace unsatisfactory segments with a new segment of cable at no cost to the Owner. Test the new segment of cable to demonstrate acceptability. Furnish photographs of the traces to the Owner for each circuit.

B. Document data for each measurement. Print data for submittals 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 submit electronically.

C. Remove malfunctioning units, replace with new units, and retest as specified above.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Validation: Test random fiber strands at OCIO's discretion to confirm validity of test results. Contractor to perform cable testing in presence of OCIO using Contractor staff and utilizing same test equipment that was used for final acceptance testing by Contractor. Smithsonian reserves the right to validate up to 100% of installed optical fiber.

3.8 DEMONSTRATION

A. As required in Section 270500, provide operating instructions.

END OF SECTION 271500

SECTION 280101 - ELECTRONIC SAFETY AND SECURITY GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for electronic safety and security work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

B. Division 01 includes sections specifying requirements for commissioning, and construction waste management.

C. Division 26 includes sections specifying requirements for raceways, boxes, conductors, and cables.

D. Division 27 includes sections specifying requirements for data cabling.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers.

B. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 28.

B. Visit the site and study aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of labor, equipment and materials, and the performance of operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for necessary signatures and paperwork, permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Owner.

E. Electronic safety and security work of this project includes, as a brief general description, the following:

1. Modification of the existing fire alarm system (installed in 2021) to accommodate the work of the project.
2. Provision of security systems including video surveillance, tied into the campus security infrastructure.
3. The project includes commissioning under the direction of a Commissioning Agent (CxA).

F. See Division 01 for requirements related to commissioning, Owner's occupancy of the premises, limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 28 specifications.

B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for coordination and additional costs as specified in article "Substitutions" below for substitutions.

C. Products specified by reference standards or by description only: Any product meeting those standards or description.

D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance, and shall not be construed as limiting competition. Contractor may use products of any manufacturer, which meet the specifications.

E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 28 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project and of representative manufacturer. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. Equipment, construction and installation must meet requirements of Smithsonian and federal governing codes.

C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

1. Furnish: Supply item
2. Install: Mount and connect item
3. Provide: Furnish and install

E. Materials and equipment shall be installed and completed in a first class and professional manner and in accordance with the best modern methods, practice and manufacturer's instructions. Any work which shall not present an orderly and neat or professional appearance shall be removed and replaced with satisfactory work when so directed in writing by the COTR.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall artisanry.

G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the COTR will determine sizes to be utilized.

H. In cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the COTR of said uncertainty, doubt, or conflict and obtain a decision as to the intent prior to initiating any work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the Architect and await a written decision.

B. Plan and coordinate work to proceed in an orderly and continuous manner without undue delay, and in conformance with the project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate electronic safety and security work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of raceway, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor's responsibility to bring this to the attention of the COTR prior to initiation of work. Correct improperly coordinated installation at no additional cost.

E. The Contractor's assistants shall include a competent electronic safety and security supervisor, who shall be on the premises at all times to check, lay out, coordinate and superintend the installation of work. The supervisor shall establish basic requirements relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers' and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of Shop Drawings and Product Data for every item of equipment. Shop drawings or product data will not be considered until Manufacturers' Lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor's name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.

3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.
4. Exclusively electronic safety and security items furnished as items associated with mechanical items but not specifically described in the mechanical item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the mechanical item by identified specification paragraph.
5. Product data sheets shall be 216 millimeters by 279 millimeters (8.5 inches by 11 inches) cut sheets for operating and maintenance manual.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of owner's representative, and project type and size.

E. After the work is completed, submit required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the COTR prior to final acceptance of the work.

1.10 SPECIALIST

A. The term "Specialist" as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer's direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:

    a. Contract drawings.
    b. Specifications.
    c. Addenda.
    d. Change orders and other modifications to the Contract.
    e. Reviewed shop drawings, product data, and samples.

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:

    a. Manufacturer's name and product model and number.
    b. Product options, substitutions, or alternates utilized.
    c. Changes made by addenda and modifications.

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:

    a. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
    b. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
    c. Field changes of dimension and detail.
    d. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.
2. Prepare covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", and title of project.

3. Internally subdivide the contents with permanent page dividers, logically organized as described below.
4. Contents: Prepare a Table of Contents, with each product or system description identified.
5. Part 1: Directory, listing names, addresses, and telephone numbers of engineers; contractor; electronic safety and security subcontractors; and major electronic safety and security equipment suppliers.
6. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

    a. Significant design criteria.
    b. List of equipment.
    c. Parts list for each component, including recommended spare parts list.
    d. Operating instructions.
    e. Maintenance instructions for equipment and systems.
    f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

7. Part 3: Project documents and certificates, including the following:

    a. Shop drawings and product data.
    b. Photocopies of certificates.
    c. Photocopies of warranties, guarantees, and bonds.
    d. Test reports: Copies of the results of tests required under sections of specifications.

8. Submit one copy in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.
9. Submit final revised copy within ten days after final inspection.
10. Submit operation and maintenance data in electronic format.

1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The electrical, building, fire, and safety codes of the state and county or city in which the work is being performed.
2. The National Electric Code, NFPA 70 (NEC).
3. The National Fire Protection Association Code. (NFPA)
4. International Building Code (IBC).
5. International Energy Conservation, Fire, and Electrical Codes (ICC).

1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply.

1. Federal Specifications (FS)
2. American National Standards Institute (ANSI)
3. American Society for Testing and Materials (ASTM)
4. International Code Council (ICC)
5. Institute of Electrical and Electronics Engineers (IEEE)
6. National Electrical Code (NEC) (NFPA 70)
7. National Electrical Manufacturer's Association (NEMA)
8. National Fire Protection Association (NFPA)
9. The Occupational Safety and Health Act (OSHA)
10. Underwriters Laboratory Inc. (UL)
11. Telecommunications Industry Association (TIA)
12. Federal Information Processing Standards (FIPS)
13. International Organization for Standardization (ISO)
14. National Institute of Standards and Technology (NIST)
15. Security Industry Association (SIA)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for contents within these areas. Provide security measures necessary for this area.

B. Area shall be maintained and shall be returned to original condition at the completion of the project.

C. Store electronic safety and security construction materials such as wire, raceways and boxes, devices, and equipment in buildings, enclosed trailers, or portable enclosed warehouses.

1. Materials and products subject to damage from moisture: Store in dry locations. If necessary, protect with protective wraps or covers.
2. Plastics and other materials and products subject to damage from heat or cold: Store at manufacturer's recommended temperatures.
3. Plastics and other materials and products subject to damage from sunlight: Protect from sunlight.

D. Electronic safety and security equipment stored before installation and installed during construction: Provide clean, dry locations at manufacturer's recommended temperatures, and cover or wrap if required to protect from incidental damage.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.
5. Protect areas occupied by Owner's personnel or equipment.
6. Seal off return air registers and other mechanical systems to prevent dust from entering.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair damage or soiling to the complete satisfaction of the COTR; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, at no addition to the Contract sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer's recommended temperatures.

E. Protect electronic safety and security materials and products from weather events and accidents of construction.

F. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.16 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.17 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in "Cutting and Patching" below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the COTR in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.18 WARRANTY

A. Work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties as specified in individual sections.

B. During the correction period, the Contractor shall begin correcting any work found to be not in accordance with the requirements of the Contract Documents within 4-hours of receiving written notice from the Owner. Provide detailed schedule for completion of work within 24-hours of receiving written notice from the Owner and revise schedule based on any Owner comments generated. Except as otherwise required in General Conditions and Division 01, the correction period is one year after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

1. Service reports for warranty work shall be provided to the Owner.

C. When use of the permanent equipment has been permitted for temporary services during construction of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers' standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.19 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractors' and subcontractors' responsibilities are described in Division 01.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of raceways. Close superfluous openings and remove debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the COTR.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.3 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or COTR finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, COTR shall be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

3.4 COMMISSIONING

A. Comply with requirements of "Commissioning" in Part 1 above.

END OF SECTION 280101

SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to work of more than one section of Division 28.

B. Basic materials and equipment required for electronic safety and security work.

C. Date sensitive equipment.

D. Electronic safety and security identification.

E. Operating instructions.

F. Testing wiring systems.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 280101.

B. Operation and Maintenance Manuals: Division 01 and Section 280101.

C. Painting: Division 09.

D. Construction waste management: Division 01.

E. Commissioning requirements: Division 01 and Division 23.

F. Common Work Results for Electronic Security: Section 280500.10. This section includes requirements that apply to video surveillance, access control, and related systems but which do not apply to fire alarm. Where the requirements of Section 280500 and Section 280500.10 differ, comply with Section 280500.10.

1.3 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

1.4 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed on the basis of using the particular manufacturers' products specified and scheduled on the drawings.

B. Products of other manufacturers that are listed under the article "Acceptable Manufacturers," or permitted as "equal," are permitted provided:

1. Product shall meet the specifications.
2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that make their use impractical or cause functional fit, access, or connection problems.

D. The contract drawings are generally diagrammatic, and do not indicate all fittings or offsets in raceway or all pull boxes, access panels, or other specialties required.

1. Install raceway exposed to view parallel with the lines of the building and as close to walls, columns, and ceilings as may be practical, maintaining adequate clearance for access at parts requiring servicing.
2. Install raceway a sufficient distance from other work to permit a clearance of not less than 15 mm (0.5 inch) between its finished covering and adjacent work.
3. No raceway shall be run below the head of a window or door.
4. Pull boxes and other appurtenances which require operation or maintenance shall be easily accessible. Do not cut or form handholes for operation or maintenance of appliances through walls or ceilings.

1.5 SUBMITTALS

A. Test reports: Show that tests specified in Part 3 below demonstrate the specified results.

1.6 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the electrical, building, fire, and safety codes and regulations of the Smithsonian Institution.

B. Electronic safety and security equipment, materials and devices provided or installed as work of Division 28 shall bear UL label, or, if UL label is not available, the item shall be tested and labeled by a qualified testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70. Provide testing, if required, without addition to the contract sum.

C. VOC content: Field-applied adhesives and sealants, limits per South Coast Air Quality Management District (SCAQMD), Rule No. 1168.

D. Products shall contain no urea-formaldehyde content.

1.7 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractors' and subcontractors' responsibilities are described in Division 01.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Nameplates: Laminated plastic, engraved, white letters on black background, except where other colors are noted or specified.

1. Size: Minimum 19 mm (0.75 inch) by 64 mm (2.5 inches).
2. Letter size: Minimum height 5 mm (0.1875 inch).
3. Fasteners: Vandalproof brass screws or rivets.

2.2 DATE-SENSITIVE EQUIPMENT

A. Date-sensitive equipment: Systems, equipment, or components which use or process date and time data in order to perform their functions.

B. Each item of date-sensitive equipment used in the project shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS AND EQUIPMENT

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify COTR if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

3.2 IDENTIFICATION

A. Items to be identified include, but are not limited to:

1. Control devices.
2. Cables.
3. Control panels.
4. Equipment
5. Other appurtenances.

B. Identify function, equipment served, and area served.

3.3 TESTS

A. During the progress of the work and after completion, test the circuits, and electronic safety and security system, and the low-voltage alarm and signal systems.

B. Results of the tests shall show that the wiring meets the requirements of this specification. Should any test indicate defect in materials or workmanship, immediately repair, or replace with new, the faulty installation, and retest the affected portions of the work.

C. Furnish equipment and instruments necessary for testing.

D. Tests shall demonstrate the following:

1. Power, control, and system circuits are continuous and free from short circuits.

2. Circuits are free from unspecified grounds.
3. Circuits are properly connected in accordance with the applicable wiring diagrams.
4. Circuits are operable.

E. Immediately repair defects and retest until systems are operating correctly.

F. Submit test reports.

3.4 OPERATING INSTRUCTIONS

A. Furnish the necessary technicians, skilled workers, and helpers to operate the electronic safety and security systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Owner or designated personnel in operation, and adjustment of systems and equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions for use by instructors and Owner personnel.

E. Schedule the general and specialized instruction periods for a time agreed upon by the COTR.

END OF SECTION 280500

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SECTION 280507.10 – POWER SOURCES FOR ELECTRONIC 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.

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SYSTEM DESCRIPTION

A. The power sources support the electronic security systems (ESS) and the telecommunications system which carries security system data.

1.3 SUMMARY

A. This Section includes the following:

1. 55-VDC Power Supplies for Power-over-Ethernet Injectors (for camera power)

1.4 DEFINITIONS

A. ESS: Electronic Security Systems

PART 2 - PRODUCTS

2.1 FIFTY-FIVE VOLT DIRECT CURRENT POWER SUPPLIES

A. Acceptable Manufacturers

1. Comnet Communication Networks
2. Approved equal

B. Comnet PS-DRA480-48A is the basis of design.

C. Minimum Required Features and Specifications

1. Input power range 90 to 264 volts AC
2. Input current at 115 volts AC: 4.9 amperes.
3. Input line frequency tolerance: 47 to 63 Hz.
4. Power dissipation: 60 watts
5. Power output adjustable between 47 and 56 volts DC.

6. Minimum load 0%.
7. Line Regulation +- 0.5%.
8. Output hold up time 25 milliseconds at 115 volts AC input.
9. Output current 10 amperes at 48 volts DC.
10. 10-ampere input fuse
11. IEC 61000-4-5 internal surge protection
12. Rated overload protection minimum 110%.
13. Overvoltage protection: auto recovery, 125 – 140%.
14. Indicating LEDs

    a. DC ON: green, at start-up.
    b. DC LOW red, after start-up.

15. Metal case
16. DIN-rail mounting
17. Environmental:
    a. Minimum 400,000 hours mean time between failures at 40^{O}C.
    b. Operating temperature -40^{O}C to 85^{O}C.
    c. Relative humidity tolerance: 20% to 95% non-condensing

D. Regulatory Approvals and Compliance

1. UL508 Listed
2. UL 60950-I Recognized
3. Meets IEC 60068-2-6 for vibration
4. Meets IED 60068-2-27 for shock

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power supplies and associated battery cabinets as directed by manufacturer.

B. 55 VDC Power Supply

1. Mount inside DIN-rail cabinet provided under the main “Renew Cheetah Conservation Station” project.
2. Set output voltage to that required by PoE injectors.

END OF SECTION 280507.10

SECTION 280509.10 – SURGE PROTECTION FOR ELECTRONIC 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 SYSTEM DESCRIPTION

A. This specification is for surge protection for electronic security systems (ESS).

B. Transient Voltage Surge Suppression:

1. Protect cables and conductors extending beyond building façade, except fiber optic cables, which serve as communication, control, or signal lines against Transient Voltage surges.
2. The surge protective device (SPD) device shall be UL listed in accordance with Standard TIA 497B.
3. Lightning and surge suppression shall be a multi-strike variety and include a fault indicator.
4. Provide protection at the field device and on each wire line circuit at the first accessible location within the building but not more than 50 ft (15 m) of the building cable entrance.
5. Fuses shall not be used for surge protection.
6. Test the inputs and outputs in both normal mode and common mode to verify there is no interference.
7. General Performance Requirements

    a. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
    b. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.3 SUMMARY

A. This Section includes the following:

1. Surge Protective Devices (SPDs)

PART 2 - PRODUCTS

2.1 SURGE PROTECTIVE DEVICE, ETHERNET POE

A. Ditek DTK-MRJPOES or approved equivalent

B. Minimum Required Features and Specifications

1. Suitable for surface mounting or DIN rail (DTK_DRK required) within the enclosure/rack.
2. Protects power, video and data PoE circuits
3. RJ45 connection with external grounding screw
4. Operating Temperature: -40 to 158 deg F (-40 to 70 deg C)

2.2 SURGE PROTECTIVE DEVICE DTK-MRJPOEX, OUTDOOR RATED

A. Acceptable Manufacturers

1. Ditek
2. Approved Equivalent

B. Ditek DTK-MRJPOEX or approved equivalent

C. Minimum Required Features and specifications

1. Housing – Polycarbonate, NEMA 4X
2. Shielded RJ45 connections
3. Operating Temperature: -40 to 70 deg C (-40 to 158 deg F)
4. PoE Plus, HiPoE for high-wattage applications
5. Compatible with CAT5e, CAT6 and CAT6A cabling

2.3 SURGE PROTECTIVE DEVICE, 120V

A. Acceptable Manufacturers

1. Ditek
2. Approved Equivalent

B. Ditek DTK-120HW approved equivalent

C. Minimum Required Features and Specifications

1. Suitable for surface mounting or DIN rail (DTK_DRK required) within the enclosure/rack.

2. Protects power (120V)
3. Approved for 20A Circuit Breakers
4. Operating Temperature: -31 to 176 deg F (-35 to 80 deg C)

PART 3 - EXECUTION

3.1 GROUNDING

A. Provide surge protective devices on Ethernet copper cabling entering any structure, within 305 mm (one foot) of the entry, that serves any of the electronic security systems' equipment.

B. For each 20-ampere 120-volt circuit serving Division 28 equipment, provide 120V surge protection within 914 mm (three feet) downstream of the supplying branch circuit breaker.

END OF SECTION 280509.10

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SECTION 280800.10 – COMMISSIONING OF ELECTRONIC 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 SYSTEM DESCRIPTION

A. This specification is for the commissioning of electronic security systems (ESS).

1.3 SUMMARY

A. This Section includes the following:

1. Commissioning of the Electronic Security Systems

PART 2 - PRODUCTS

2.1 THERE ARE NO PRODUCTS IN THIS SPECIFICATION

PART 3 - EXECUTION

3.1 PERFORMANCE REQUIREMENTS

A. General

1. Refer to Project Process Diagram (PPD) in 280500.10. Utilize the PPD to develop effective and timely project schedules and submissions to ensure project is substantially complete prior to occupancy.

3.2 CONTRACTOR'S FIELD TESTING

A. Perform the Contractor Field Test (CFT) of all devices utilizing OPS provided forms.

B. Submit test results, including journal logs from CCURE, to COTR and OPS-PPSD.

3.3 PERFORMANCE VERIFICATION TEST (PVT)

A. Based on the OPS-PPSD approval of the Contractor's Field Test, the COTR will schedule the PVT with the Contractor and OPS-PPSD.

B. OPS-PPSD will witness the Contractor conduct the PVT of all devices utilizing the same form as for the CFT.

C. OPS-PPSD reserves the right to stop and abort testing as soon as 10 technical deficiencies are found requiring correction.

1. If the acceptance test is aborted, the re-test will commence from the beginning with a retest of components previously tested and accepted.
2. The Contractor is responsible for all time, travel, and lodging expenses incurred for personnel required to be present for resumption of the PVT.

D. The PVT also includes a physical inspection of the installation quality and workmanship.

E. Submit test results, including journal logs from CCURE, to COTR and OPS-PPSD.

END OF SECTION 280800.10

SECTION 282000 – VIDEO

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. Related Sections

1. Conduits: Section 260533.
2. Equipment foundations: Section 260528.
3. Excavation and fill for electrical work: Section 260501.
4. Power supplies for PoE Injectors: Section 280507.10.

1.2 SYSTEM DESCRIPTION

A. The Video Assessment and Surveillance System (VASS) is an enterprise class system. Integrate with the PACS so the PACS provides a single unified control and management platform. Link video to events and alarms on all other systems (intrusion detection, intercommunications, and PACS) with the PACS.

B. This is an extension of the Owner's existing American Dynamics Victor system.

C. Modify existing NVR as needed to integrate new camera feeds into the existing NZP video surveillance network. Provide necessary associated licenses.

1.3 SUMMARY

A. This Section includes the following:

1. Cameras
2. Poles

1.4 DEFINITIONS

A. Pole: A support used to carry a security camera, provided with

1. Internal attachments for wiring
2. External attachments for brackets (if any) and camera.

1.5 SUBMITTALS

A. Product data: Submit for each type of pole.

1. Length and diameter
2. Appurtenances

B. Shop drawings shall show complete dimensions of complete assembled unit with accessories. Include wiring diagrams, showing clearly manufacturer-installed and field-installed wiring.

1.6 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 280500, Common Work Results for Electrical.

B. As specified in Section 280500.10 Common Work Results for Electronic Security

PART 2 - PRODUCTS

2.1 MULTI-LENS DOME CAMERA, 20MP

A. Acceptable Manufacturers

1. Johnson Controls / Tyco
2. Arecont Vision
3. Hanwha
4. Approved Equivalent

B. Basis of Design is the Johnson Controls Illustra Pro-Gen4-20MP PTRZ.

C. Minimum Required Features and Specifications

1. Multiple Lens Options in a single camera housing
2. 3 axis gimbal; up to 4 individual camera gimbals can be independently placed in any orientation around a 360 degree track with extra positions for looking straight down
3. Image Sensor: 4 x 5MP CMOS
4. Resolution

    a. 2560 x 1920 (5MP) 4:3
    b. 2560x1444 (4MP) 16:9

5. Dynamic Range: 120 dB
6. Frame Rates:

    a. 30 FPS at 5MP.
    b. 60 FPS at 2MP.

7. Remote Focus
8. True day/night functionality with CF removal
9. PoE 802.3bt, Type 4 Class 8, 24VAC, Max Draw 71.3 watts
10. Outdoor rated IP66 and IK-10 Impact-Resistant Housing
11. H.264 / H.265 Motion JPEG and multi-streaming
12. Minimum Illumination:

    a. Color: 0.11 Lux
    b. B/W (Night Mode): 0.06 Lux, IR sensitive

13. Operating Temperature: -40 to 131 deg F (-40 to 55 deg C)
14. Humidity: 0% to 90% (non-condensing)
15. Total dimensions: 11.8 inch diameter by 6.7 inch height (299 mm diameter by 169 mm height)

2.2 POWER-OVER-ETHERNET POWER SUPPLY

A. Acceptable Manufacturers

1. Provide Power-over-Ethernet injector from same manufacturer as camera.

B. Basis of Design is the Johnson Controls / Tyco Illustra IA-POE-90-U00.

C. Minimum Required Features and Specifications

1. IEEE 8023.3bt Gigabit 90W PoE Injector
2. 90-watt capacity per port
3. 24 volt AC
4. Can handle data and power simultaneously.
5. Communications

    a. 10/100/1000Bast-T (X)
    b. Protocol: IEEE 802.3, 802.3u, 802.3x, 802.3af/at/bt, 802.3ab
    c. Transmission Distance: Up to 100 meters using Ethernet
    d. Transmission Speed: Up to 1000 Mbps.

6. Connectors:

    a. Data in: RJ45
    b. PoE out: RJ45

7. PoE and SYS LED indicators
8. Reverse Polarity protection
9. IP40 metal shell with solid mounting kit
10. UL62368 compliant
11. Environmental:

    a. Temperature:-40 to 75°C (-40 to 167°F)
    b. Relative Humidity: 10 to 95% (non-condensing)

2.3 CONCRETE

A. Concrete shall be 31,026 kilonewtons/square meter (4,500 psi) strength unless otherwise noted.

2.4 SECURITY CAMERA POLES

A. Metal security camera poles: Provide metal, raceway type, security camera poles, of sizes and types indicated, comprised of shafts and tenon joints. Construct of the following materials and additional construction features:

1. Material: Aluminum.
2. Configuration: Anchor base type with hand hole and cover where indicated.
3. 3.7 meters (12') high, 102 mm (4"), square, straight pole.
4. 0.92 square meter (9.88 square feet) effective projected area load capacity at 161 kilometers/hour (100 miles/hour) winds.
5. Black gloss smooth finish powder coat paint over titinated zirconium conversion coating.

B. Basis of Design is the Kim Lighting model # PSA12-41252-FM-BLS.

PART 3 - EXECUTION

3.1 GENERAL

A. Install system components and appurtenances in accordance with the manufacturer's instructions, ANSI C2, and furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.

B. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram, if available, for schematic system installation/termination/wiring data.

C. Attach equipment to walls and ceiling/floor assemblies and be held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

D. Current Site Conditions: Visit the site and verify site conditions agree with the design package. Report all changes to the site or conditions that will affect performance of the system to the COTR. Do not take any corrective action without written permission from the COTR.

E. Cameras

1. Install cameras with the proper focal length lens as indicated for each zone
2. Set cameras with fixed iris lenses to the proper f-stop to give full video level
3. Aim camera to give field of view as needed to cover the alarm zone / intended field of view
4. Aim fixed mount cameras installed outdoors facing the rising or setting sun sufficiently below the horizon to preclude the camera looking directly at the sun
5. Focus the lens to give a sharp picture over the entire field of view.
6. Use a fine focus target for final focus adjustments.

F. Power Supplies

1. Provide a dedicated Power-over-Ethernet power supply for each camera, providing 24 volts AC power
2. Locate the power supply in the IT room of the main Cheetah Conservation Station (Building D).

G. Camera Pole Mounts: Install the camera mount as specified by the manufacturer and as shown. Install poles, accessories, and fixtures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NFPA 70, NESC and NEMA standards, and with recognized industry practices.

1. Provide mounting hardware sized appropriately to secure the mount, camera and housing with maximum wind and ice loading encountered at the site.
2. Provide electrical and signal transmission cabling to the mount location.
3. Connect signal lines to mount interfaces.
4. Connect pole wiring harness to camera.
5. Paint camera mount arms and brackets gloss black, smooth finish prior to installation, matching the color of the poles, in accordance with manufacturer's recommendations.

3.2 INSTALLING POLES

A. Provide reinforced concrete bases as shown on the drawings. Chamfer exposed edges of concrete. Grout base plates to concrete bases to provide proper leveling.

B. Base size and depth shall be as indicated on the drawings.

C. Use belt slings or rope, not chain or cable, to protect finishes when raising and setting finished poles.

D. Set poles plumb. Support adequately during backfilling, or when anchoring them to the foundations.

E. Provide sufficient space encompassing hand-access and cable-entrance holes for installation of underground cabling where indicated.

F. Fasten brackets securely to indicated structural supports, including poles; and ensure that installed fixtures are plumb and level.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the National Electrical Code.

3.3 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.

END OF SECTION 282000

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SECTION 283111 - ADDRESSABLE FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and General Provision of Contract, including General and Special Conditions and Division 1 Specification Section, apply to work of this Section.

B. Related Sections:

1. General and Special conditions
2. Division 1: Submittals
3. Division 7: Firestopping
4. Division 9: Painting
5. Division 26:

    a. Basic Electrical Requirements
    b. Wires and Cables
    c. Raceways
    d. Identification for Electrical Systems

1.2 SUMMARY

A. Scope: This work includes designing and providing modifications to the existing addressable fire alarm system as described herein and on the contract drawings for renovations to the Kudu Barn at the Smithsonian Institution, National Zoo & Conservation Biology Institute. The system shall include all wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, alarm and supervisory signals, initiating devices, alarm notification appliances, interfaced equipment, and all other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described.

B. Existing Equipment: Existing fire alarm control panel and associated head-end equipment shall be maintained fully operational. Existing to remain initiating and notification appliances shall be protected during the work and reconnected.

1. Keep existing to remain fire devices active for as long as the facility they serve is occupied by the Smithsonian Institution or others except as described in Paragraph 1.9(A) and its subparagraphs, below.
2. Wiring between the existing fire alarm control panel and existing to remain appliances shall be removed during the project. New wiring shall be installed between the existing fire alarm control panel and existing to remain appliances.

3. When an existing to remain appliance is no longer connected to the fire alarm control panel, it shall be labeled "NOT IN SERVICE" until the work is completed and accepted. As new equipment is installed, it shall be labeled "NOT IN SERVICE" until the new equipment is accepted.
4. Once the final configuration of the fire alarm system is installed, tested, and accepted by the Smithsonian, the labels on the new and existing to remain equipment shall be removed.
5. Contractor shall work with the Smithsonian to program the zoo-wide fire alarm network as required to accommodate work on the Cheetah Conservation Station fire alarm system.

C. Repair/Service Replacement Parts: Repair services and replacement parts for the system shall be furnished under this contract after the date of final acceptance of work by the Smithsonian Institution. On-site service during the warranty period shall be provided within 24 hours after notification. All repairs shall be completed within 48 hours after notification.

D. All required testing of the fire alarm system, to include all connected devices as outlined in this Section. Testing shall also include intelligibility of the fire alarm system as outlined in Article 3.6. E.14 of this Section.

1.3 DEFINITIONS

A. COTR: Contracting Officer Technical Representative

B. FM: FM Global (Factory Mutual)

C. FPE: Fire Protection Engineer

D. Furnish: To supply the stated equipment or materials

E. Install: To set in position and connect or adjust for use

F. NFPA: National Fire Protection Association

G. NICET: National Institute for Certification in Engineering Technologies

H. OSHEM: Office of Safety Health and Environmental Management

I. Provide: To furnish and install the stated equipment or materials

J. UL: Underwriters Laboratories

1.4 SYSTEM DESCRIPTION

A. The existing System is a complete, supervised, noncoded, addressable multiplex fire alarm system with voice/strobe evacuation, intelligent analog alarm initiation, conventional smoke detection initiation, and complying with all aspects of the applicable documents listed herein. Modifications of the system shall not diminish its capabilities.

1.5 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 72 and all contract documents and specification requirements.

B. The system is and shall remain classified as a proprietary protective signaling system.

C. Control features:

1. The system fire alarm control panel is tied-to the central monitoring system. The Keltron monitoring system uses the existing SI network to communicate fire alarm conditions. A compatible fire alarm system, the appropriate Keltron LS Net transceiver and associated network connections must be installed. The final connections and programming will be performed by SI staff.
2. The system shall provide a field test function where one person can test the complete system or a specified area at the fire alarm control panel while maintaining full operational function of other areas not under test. Alarms, troubles, device types, and the initiation device addresses shall be logged to the system printer and historical memory.
3. Ensure the existing manual pull station attached to the fire alarm control panel activates the general alarm. Resetting the manual pull station (and all other activated alarms) will cause the general alarm to cease operating. OSHEM must approve the final sequence of operation.

D. Supervision

1. Class B initiating device circuits.
2. Class B signaling line circuits.
3. Class X signaling line circuits for the network.
4. Class B notification appliance circuits.
5. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.
6. Provide electrical supervision of the circuits leading to interfacing modules for the monitoring of contact type initiation devices, the control of electrical devices, and each independent smoke detection system.

E. Alarm Functions: Fire alarm system functions and operations shall be as indicated on the Alarm Function Matrix included at the end of this part. Operation of an alarm initiating device shall cause the functions indicated on the matrix to occur as described below:

1. Initiate Pre-signal Alarm: This function shall cause an audible and visual alarm and indication to be provided at the FACP. Activation of an initiation device will be annunciated at the FACP only, without activation of the General Evacuation Alarm.
2. Illuminate LED on Device in Alarm: This function shall cause an LED, integral to a device, to illuminate, indicating that the device is in alarm. For contact devices, such as sprinkler valve tamper switches, the LED shall be built into the intelligent system interface module monitoring the device.
3. Activate audio/visual signals and display address on the FACP: This function shall illuminate an alarm indicating LED, sound an audible alarm, and display a device address at the FACP when the system is in an alarm condition. Signals shall also be transmitted to a computer control display system.
4. Transmit Event to Central Monitoring Station: This function shall cause the event to be transmitted to the central monitoring station at the Smithsonian Institution SIPPS Control Center. The message sent shall include the building of origin and the identical message displayed on the fire alarm control panel LCD display board.
5. Print Address, Date, Time, and Type of Alarm: This function shall cause the fire alarm system printer to print a message identical to that shown on the FACP LCD display board.
6. Activate Audio/Visual Signals and Address Display on Remote Panel or Graphic Annunciator Panel: This function shall cause the event to be transmitted to a remote panel, whose location is shown on the drawings. The message sent shall be the same message displayed on the FACP LCD display board.
7. Signal Confirmation: This function shall cause the fire alarm control panel to reset the activated device and wait for a second alarm activation. Alarm conditions are processed through a confirmation period of 45 seconds. Over the next 300 seconds, a signal justification period is initiated where any subsequent alarms are reported immediately.

F. Trouble Functions: Provide the following actions and indications at the FACP upon a single break, open condition, or ground fault on all supervised circuits which may prevent the required operation of the system:

1. Annunciate at the FACP: A yellow visual signal, audible alarm, and alphanumeric LCD display of type of trouble, and device address.
2. The fire alarm system printer shall print a message identical to that shown on the LCD display on the FACP. In addition, the printed hard copy of the event shall indicate the date and time at which it occurred.

3. Send a signal to the existing central monitoring system. This message shall include the building of origin as well as all information indicated to be displayed on the FACP.
4. Send a signal to the remote panel shown on the drawings. This message shall include the building of origin as well as all information indicated to be displayed on the FACP. The message sent shall be the same message displayed on the FACP LCD display board.
5. Each independent fire detection system shall be monitored for trouble conditions. Each monitored condition shall be provided with a separate address.

G. Fire alarm signal initiation shall be by one or more of the following devices installed under this project:

1. Heat detector

H. System trouble signal initiation shall be by one or more of the following devices or actions:

1. Loss of primary power at the FACP.
2. Ground or a single break in FACP internal circuits.
3. Abnormal ac voltage at the FACP.
4. A break in standby battery circuitry.
5. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
6. Failure of battery charging.
7. Abnormal position of any switch at the FACP or annunciator.
8. Amplifier failure
9. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.

1.6 SUBMITTALS

A. General: Refer to Section "SUBMITTALS" for basic information relating to submittal requirements. Submit 6 complete sets of submittals. Partial submittals will not be acceptable and will be returned without review. Before any work is commenced, the submittal must be approved by the Office of Safety, Health and Environmental Management (OSHEM). Any work performed by the contractor prior to their approval will be at the contractor’s own risk. If such work is contrary to applicable codes and contract documents, the contractor shall bear all costs including, but not limited to, demolition, reconstruction, and all costs and expenses associated with revising the fire alarm system to meet all applicable codes and contract document requirements.

B. System Description: Submit a detailed description of the control panel as it shall operate for this specific installation. General system descriptions from the catalog cuts and copies of the Systems Design Operation portion of this specification will not be acceptable.

C. Equipment: Include annotated catalog data showing manufacturer's name, model, voltage, and catalog numbers (for all equipment and components provided or modified under this project) of the following:

1. Fire Alarm Control Panel (FACP) components added to an existing FACP under this project
2. Fire Detector (smoke, heat, etc.)
3. Wire
4. Boxes
5. Terminal strips
6. Raceway
7. Support

D. Shop Drawings: Provide 5 sets of working drawings and 1 set of reproducible mylar sepia on sheets not smaller than 609 mm by 914 mm (24 inches by 36 inches). Shop drawings shall be prepared on a Computer Aided Drafting (CAD) System. As a minimum, the shop drawing submittal shall include the following:

1. Interior wiring diagram for FACP if relevant to the work of this project.
2. Provide point-to-point wiring diagrams on floor plans at a scale of not less than 1:100 (1/8” = 1’-0”), showing all field devices installed or modified under this project (indicating and initiating devices, relays, switches, etc.), field interconnections installed or modified under this project, the routing of raceway and circuits installed or modified under this project between devices, electrical boxes, terminal cabinets, risers, and the FACP. All device circuit numbers and addresses shall be indicated.
3. Field wiring color code scheme.
4. Locations for all ceiling mounted equipment shall be coordinated with luminaires, air outlets, ductwork and other fixtures. All detectors shall be centered and aligned with ceiling tiles and/or other ceiling mounted devices.
5. Provide complete riser diagrams indicating the wiring sequence of all devices installed or modified under this project and their connections to the control equipment. Provide a color code schedule for the wiring. Provide floor plans showing the location of all devices and equipment installed or modified under this project.
6. Detailed sequence of operations and matrix.

E. As-Built (Record) Working Drawings: On a daily basis the contractor's superintendent shall record as-built conditions on a set of Shop Drawings maintained at the job site. Two sets of Shop Drawings reflecting as-built conditions shall be available prior to and for use in the final acceptance test. Two weeks after the acceptance test and before final acceptance of the work, furnish four complete sets of as-built drawings. The drawings shall be prepared on uniform sized sheets not less than 609 mm by 914 mm 24 inches by 36 inches). The drawings shall include:

1. As-built location of all devices and equipment installed or modified under this project. Device addresses shall be listed next to each device
2. Complete wiring diagrams showing connections between all devices and equipment installed or modified under this project. Each conductor shall be numbered at every junction point with indication of origination and termination points.
3. Riser diagram for all work installed or modified under this project.
4. All deviations from the project drawings and approved shop drawings.

F. Record Drawing Software: Provide three (3) compact discs containing CAD based drawings in DXF format of all as-built drawings and schematics.

G. Device Addresses: Prior to fire system installation, for all devices installed or modified under this project, provide for approval a complete list of device addresses with corresponding commands, controls, and sequence of operation.

H. LCD Display Messages: The fire alarm control panel shall display messages in the following format: Device type, Floor, Room/Location. All messages for tamper and waterflow switches shall also display the zone and device location.

I. Qualification Data: For Designer and Installer.

J. Descriptions on Graphic Annunciators: Prior to fire system installation, provide updated descriptive labels (if necessary) for graphic annunciator labeling which will include strobe and voice evacuation zones.

K. Service Manuals and Equipment Descriptions: Thirty days prior to the final acceptance test and after the preliminary testing has been completed submit the following:

1. Furnish four (4) bound copies of complete service manuals to include: device and board specifications, operation, installation, and maintenance manual; manufacturers installation instructions for all aspects of the installation; Walktest Operating Instructions; manufacturer’s wiring specifications for the system; and training manual.
2. Maintenance checklists for equipment installed or modified under this project.

3. As-built circuit diagrams, complete with color-code scheme, and device descriptions for work installed or modified under this project.
4. Complete parts list for parts installed or modified under this project by make model number and manufacturer.
5. Copies of approved submittal materials.

L. Calculations: For each panel supplying a circuit installed or modified under the project, submit substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component shall be submitted with the calculations. Calculations shall include:

1. Battery capacity calculations.
2. Supervisory power requirements for all equipment.
3. Alarm power requirements for all equipment.
4. Power supply rating justification showing power requirements for each of the system power supplies.
5. Justification showing power requirements of the system amplifiers. Amplifiers shall be sized for a minimum of 1 watt per connected speaker in common areas and 0.5 watt per speaker in all other locations.
6. Voltage drop calculations for NAC wiring runs demonstrating worst-case condition. Show capability of 25 or 70.7 vrms circuits for wire runs.
7. Provide complete battery calculations for both the alarm and supervisory power requirements. Ampere-hour requirements for each system component shall be submitted with the calculations.

M. FACP Wire Chart: Prepare a system wire chart. Chart every wire installed or modified under this project showing the wire number, color, size, type of circuit, designation, origination point and termination point. The chart shall be typewritten with minimum 12-point lettering on paper that is 215.9 mm by 279.4 mm (8.5 inches by 11 inches). The format of the wire chart shall be as shown on the contract drawings. Provide one copy of the wire chart in a sealed plastic envelope inside the fire alarm control panel.

N. Terminal Cabinet Wire Chart: Prepare a wire chart of the wires in each terminal cabinet installed or modified under this project. Chart every wire installed or modified under this project showing the wire number, color, size, type of circuit, designation, origination point and termination point. The chart shall be typewritten with minimum 12-point lettering. The format of the wire chart shall be as shown on the contract drawings. The chart must be protected with a clear laminate and mounted in each cabinet so that it does not interfere with the wiring or terminals.

O. Work Schedule: All work must be coordinated with facility operations. Zoo operations may require limited access to areas, arranging for zoo security personnel to accompany contractors in non-public areas, and working during off-hours. Prior to initial work, meet with zoo staff to establish a work schedule. A work schedule must be submitted for approval prior to initial work.

P. Certificate of Compliance: Within two weeks after passing the acceptance test submit a certificate of code and contract compliance to the COTR in accordance with NFPA 72, Paragraph 1-7.2.1.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. Testing Services or Laboratories: Construct all fire alarm and fire detection equipment in accordance with the latest edition of the following publications from Underwriters Laboratories (UL) and Factory Mutual Engineering Corporation (FM):

a. UL Fire Protection Equipment Directory
b. UL Electrical Construction Materials Directory
c. UL 38 – Manually Actuated Signaling Boxes for Use With Fire Protection Signaling Systems
d. UL 464 - Audible Signal Appliances
e. UL 497A – Secondary Protectors for Communications Circuits
f. UL 521 - Heat Detectors for Fire Protective Signaling Systems
g. UL 864 - Control Units for Fire Protective Signaling Systems
h. UL 1283 – Electromagnetic Interference Filters
i. UL 1449 - Transient Voltage Surge Suppressors
j. UL 1480 - Speakers for Fire Protective Signaling Systems
k. UL 1971 - Signaling Devices for the Hearing Impaired
l. FM Approval Guide

2. Codes and Standards

a. International Building Code, Latest Edition
b. Life Safety Code, Latest Edition
c. NFPA 70, National Electrical Code
d. NFPA 72, National Fire Alarm Code, 2002 Edition
e. Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).

B. Qualifications of Installer: Design shall be by a NICET Level III or IV Technician or a Registered Fire Protection Engineer. Installer shall have an office, which has been in existence for at least 3 years, within a 75-mile radius of the U.S. Capitol. Installation shall be accomplished by an electrical contractor with a minimum of five years' experience in the installation of fire alarm systems of similar size and capacity. The services of a technician provided by the control equipment manufacturer shall be provided to supervise installation, adjustments, and tests of the system.

C. Distributor/ Service Organization/ Designer Qualifications: Design Personnel certified by NICET as Fire Alarm Level III or IV. The manufacturer's equipment distributor shall show evidence of certification by the manufacturer in the technical support of the system installed under this contract.

1. The distributor shall show evidence of certification of at least one employee by the National Institute for Certification in Engineering Technologies (NICET) at Level III or IV in the Fire Alarm Systems subfield of Fire Protection Engineering Technology. If such a certified individual is not employed, adequate documentation shall be provided to show comparable training and experience of an existing employee. At a minimum, comparable training and experience shall consist of ten years of progressive experience in the installation and design of fire alarm systems of similar size and complexity to that specified herein.
2. In lieu of an employee with NICET Level III or IV certification, the distributor shall show evidence of at least one employee with a minimum of ten years of progressive experience in the design of fire alarm systems and, in addition, the distributor shall show evidence of technical support in the design, installation, and testing of the systems from a manufacturer-affiliated company, which shall show evidence of certification of at least one employee by the National Institute for Certification in Engineering Technologies (NICET) at level III or IV in the Fire Alarm Systems subfield of Fire Protection Engineering Technology.
3. The Contractor shall furnish evidence that the fire alarm equipment supplier has an experienced and effective service organization, which carries a stock of repair parts for the system being furnished. Should the Contractor fail to comply with the service requirements of this section, the Smithsonian will then have the option to make the necessary repairs and back-charge contractor without any loss of warranty as provided by the contract documents.

D. 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.

1.8 DELIVERY STORAGE AND HANDLING

A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.

B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Fire Alarm Service: Do not interrupt fire alarm service to facilities occupied by The Smithsonian Institution or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify COTR no fewer than two days in advance of proposed interruption of fire alarm service.
2. Do not proceed with interruption of fire alarm service without The Smithsonian Institution's written permission.

B. Temporary power to Existing Fire Alarm Service: During construction, both normal and emergency power to the facility will be interrupted. Provide temporary normal power to keep the fire alarm control equipment fully functional during construction. As the facility will not be occupied during construction, it is acceptable for the existing equipment's battery backup power to serve as the only emergency source.

1.10 COORDINATION

A. Coordinate fire alarm device layout with reflected ceiling plan and all ceiling – mounted equipment, including diffusers, luminaires, security cameras, sprinkler heads, exit signs, and other devices.

B. Coordinate major equipment and raceway layouts with other trades to avoid obstructions and excessive changes in direction for raceway.

1.11 WARRANTY

A. The contractor shall guarantee labor, materials, and equipment provided under this contract against defects for a period of one year after the date of final acceptance of this work by the Smithsonian and after the receipt of as-built drawings and schematics of all equipment.

1.12 SERVICE AGREEMENT

A. Once the fire alarm system work has been accepted by The Smithsonian, it will be maintained by the Smithsonian. There is no need for a service agreement.

1.13 EXTRA MATERIALS

A. Spare parts shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be suitably packaged and identified by nameplate, stamping or tagging.

B. Furnish the following spare parts. Quantity shall be two percent of the installed number of devices, but not less than the quantities listed:

1. Heat detectors of each type provided under this project: two
2. Fuses for each fused circuit installed or modified under this project: five
3. Lamps for each lamp type furnished: five

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. FACP components, cabinets, and peripheral devices: use only products from FireLite (Honeywell), the manufacturer of the existing fire alarm system.
2. Wire and Cable: Comtran Corporation.

    a. Helix/HiTemp Cables, Inc.; a Draka USA Company.
    b. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.
    c. West Penn Wire/CDT; a division of Cable Design Technologies.
    d. Approved equal.

3. Raceway:

    a. Allied
    b. Approved equal

4. Boxes, supports, terminal blocks, and appurtenances:

    a. As per Section Division 26

2.2 EXISTING FIRE ALARM CONTROL PANELS (FACP)

A. Use the existing fire alarm control panels: FireLite Model ES-50X.

B. Circuits

1. Existing circuits may be used to connect new devices to the FACP. Each circuit shall, after installation of the new devices, have at least a 20% spare capacity.
2. If the capacity of existing circuits is insufficient to meet the spare capacity requirement above, provide new circuits originating in the same FACP that serves fire alarm devices in the project vicinity.

2.3 FIRE DETECTORS

A. Heat Detectors:

1. Heat detectors in barns and other outdoor areas shall be conventional weatherproof type.
2. Heat detectors shall be 57^{O}C (135 ^{O}F), rate-compensating detectors.
3. The detectors furnished shall be U.L. listed for use in the FACP and environment conditions.
4. The detector shall be addressed, tested and programmed prior to installation.
5. Detectors shall be equipped with screw terminals for each conductor.
6. Detectors shall be hermetically sealed and of the automatically resetting type which will operate when ambient air temperature reaches detector setting regardless of rate of temperature rise.
7. Detector operation shall not be subject to thermal lag.

2.4 MANUAL PULL STATIONS:

A. Protect the existing-to-remain pull station.

2.5 NOTIFICATION APPLIANCES

A. Speakers and strobes shall be 24 or 70 VDC and shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring. Indoor devices shall be mounted to a 4 inch (101 mm) square outlet boxes. Outdoor devices shall be mounted to weatherproof boxes as recommended by manufacturer.

B. Speakers: Provide fire alarm speakers conforming to U.L. 464.

1. Speakers shall be provided with at least the following four tap settings: 2-watt, 1 watt, 1/2 watt, and 1/4 watt.
2. The audible signal shall have two alternate and distinct audible patterns; horn tone and recorded voice message; each field switchable for peak output levels of 100db or

106db measured at 3048mm (10 feet). When multiple tones are activated simultaneously, the tones shall be prioritized to avoid interference.
3. System shall meet intelligibility requirements of NFPA 72 and this Section.
4. Finish:

   a. Indoor: white.
   b. Outdoor: red.

C. Strobe lights

1. Provide with red finish plate and with the word "ALERT" horizontally printed for ceiling mounting.
2. Xenon strobe with a minimum repetition rate of 1 HZ, not exceeding 3 HZ and a maximum duty cycle of 40% with a pulse duration of 0.2 seconds.
3. Visual alarm signals shall be furnished with minimum light intensity of 75 candela and meet the requirements of ADA and UL 1971. In large rooms with ceilings over 10 feet, 110 candela models shall be provided. Any device up to 110 cd shall have adjustable candela ratings.
4. Provide strobe light visual alarm signals which operate on 24 VDC.
5. Synchronization shall be provided as required in NFPA 72.

D. Audio-Visual Combination Assemblies shall be provided where strobes and speakers are identified at the same locations.

2.6 INTERFACE MODULES:

A. Furnish intelligent analog signaling circuit interface modules for the monitoring of contact type initiation devices, the control of electrical devices, and load control relays (controlling HVAC equipment). The modules shall be capable of monitoring three separate functions: alarm, trouble and supervisory conditions.

B. The module shall be addressed, tested and programmed prior to installation using a U.L. listed programmer/ tester.

C. The module shall display a steady LED for each circuit, in the normal power or standby power condition, when in the alarm state or during control circuit is activation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment, materials, installation, artisanry, examination, inspection, and testing shall be in accordance with NFPA 72, except as modified herein.

3.2 SYSTEM FIELD WIRING AND RACEWAY

A. Wiring Within Cabinets and Junction Boxes: Provide wiring installed in a neat and professional manner and installed parallel with or at right angles to the sides and back of any box or cabinet.

B. Conductor Type and Size: Wire size shall be sufficient to prevent voltage drop problems. Wire type and sizing of conductors shall be in accordance with the manufacturers wiring specifications for the system, except for minimum wire size shall be as follows:

1. Signaling Line Circuits: 16AWG, Type FPLR, solid copper, shielded
2. Notification Appliance Circuits: 14AWG, Type FPLR, solid copper, twisted pair, shielded
3. Interfaced Circuits: 16AWG, Type FPLR, solid copper, shielded

C. Connectors: All conductors shall be terminated at a screwed connector on a securely mounted approved pressure type terminal block. The use of twist-on wire connectors or similar devices shall be prohibited.

D. Terminal Cabinets: Provide a terminal cabinet at the base of any circuit riser, on each floor at each riser, and where indicated on the drawings. Cabinet size shall be appropriate for the size of the wiring to be connected.

E. Conductor Numbering: All conductors installed or modified under this project in the system shall be numbered at every junction point. Use a numbered shrink-wrap label designed specifically for this purpose. Wire numbers shall be the same as those designated on the as-built drawings. Mark each terminal in accordance with the wiring chart and diagrams of the system.

F. Conductor Color Coding: Color coded conductors shall be consistent for each type of circuit. When renovating or adding to an existing system, color coding shall match the existing system.

G. Junction Boxes: Any junction box used in a circuit shall be dedicated to that circuit. A common junction box is not permitted for routing multiple circuits.

H. Signaling Line and Notification Appliance Circuits

1. Signaling Line, notification appliance, and power circuits shall each be in separate raceway.
2. Strobes are to be connected to circuits separate from speakers. This includes strobes and speakers that are mounted as a unit.

3. Provisions for tying-in signaling line and notification appliance circuits directly to the FACP mother board (board containing CPU) shall not be used. Initiation and indicating circuits shall be tied to a separate electronic board before connection to the mother board.

I. Circuit Loading:

1. Circuits operating at 24VDC shall not operate at less than 21.6 volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 10% of nominal voltage.

J. Raceway:

1. All conductors shall be in grounded metal raceway. Raceway shall be rigid metal or EMT. Flexible metal raceway not exceeding 1830 mm (six-foot) lengths shall be permitted from junction box to initiating device. On flexible metal conduit, use only insulated throat connectors.
2. Run raceway concealed unless specifically shown otherwise on the drawings.
3. Minimum raceway size shall be 21 mm (3/4-inch).

3.3 FIRESTOPPING

A. Seal all holes caused by penetrating raceway, piping, or other penetrations which pass through floors, walls or ceilings. Firestop penetrations through floor slabs, fire-rated walls, shafts, or any fire-rated assembly in accordance with Section 078413, Penetration Firestopping.

3.4 MARKING

A. All metal surfaces installed or modified under this project shall be painted. Metal raceway in finished areas shall be painted the color to match adjacent surfaces. Junction boxes in unfinished areas shall be painted a full gloss enamel red. Painting shall be in accordance with Division Nine.

B. Red bands shall be applied every 3.05 m (10 feet) when not using red-colored raceway.

C. Prior to acceptance testing each fire alarm initiating device installed or modified under this project must be labeled with the device address.

3.5 DEVICE INSTALLATION

A. Manual Pull Stations: reconnect existing to remain fire alarm pull station.

B. Wall mount strobes installed or modified under this project shall be a minimum of 2032 mm (80 inches) above the finished floor or 152 mm (6 inches) below the ceiling whichever is lower.

C. Heat Detectors:

1. The indicating LED on the smoke detector shall be visible from the floor. Where ceiling conditions prevent easy viewing of the LED from the floor, a remote indicating lamp must be installed.

3.6 TESTS

A. Prior to starting work, perform load tests on circuits affected by the work of this project and document the results.

B. Test Equipment: Supply personnel, communication devices, and all equipment necessary for performance of the final test.

C. Megger Tests: After all wiring has been installed, and prior to making any connections to panels or devices, all wiring modified or installed under this project shall be megger tested for insulation resistance, grounds, and/or shorts. Conductors with 300 volt rated insulation shall be tested at a minimum of 250 VDC. Conductors with 600 volt rated insulation shall be tested at a minimum of 500 VDC. The tests shall be witnessed by OSHEM and the Contracting Officer and test results recorded for use at the final acceptance test.

D. Loop Resistance Tests: Measure and record the resistance of each circuit installed or modified under this project with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the Contracting Officer and OSHEM and test results recorded for use at the final acceptance test.

E. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits installed or modified under this project are functioning properly. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions installed or modified under this project were tested and operated properly. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.

F. Final Acceptance Test: Notify the Contracting Officer in writing when the system is ready for final acceptance testing. Submit request for test at least 14 calendar days prior to the test date. A final acceptance test will not be scheduled until megger test results, the loop resistance test results, and the submittals required in Part 1 are provided to the Contracting Officer. Test the system in accordance with the procedures outlined in NFPA 72. The required tests on all circuits and components installed or modified under this project are as follows:

1. Verify the absence of unwanted voltages between circuit conductors and ground.
2. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
3. Complete operational tests under emergency generator power
4. Complete operational tests under battery power and as described above under battery power. Test the battery charger.
5. Test each initiating and indicating device and circuit for proper operation and response. Disconnect the confirmation feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.
6. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
7. Verify several of the audibility and intelligibility results that were recorded on the as-built drawings as part of the preliminary testing above.
8. Visually inspect all wiring.
9. Verify that all software control and data files have been entered or programmed into the FACP.
10. Verify that Shop Drawings reflecting as-built conditions are accurate.
11. Measure the current in circuits to assure that there is the calculated spare capacity for the circuits.
12. Measure voltage readings for circuits to assure that voltage drop is not excessive.
13. Measure the voltage drop at the most remote appliance on each notification appliance circuit.

END OF SECTION 283111

SECTION 31 1000 – SITE CLEARING

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. Protecting existing trees, shrubs, groundcovers, plants and grass to remain.
2. Removing existing trees, shrubs, groundcovers, plants and grass.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, site utilities
7. Temporary erosion- and sedimentation-control measures.

B. Related Sections:

1. Section 015713 "Temporary Erosion and Sediment Control" for temporary erosion and sedimentation control measures.
2. Section 024119 "Selective Demolition" for partial demolition.

1.3 Applicable Specifications

A. Erosion and Sediment Control Field

B. American Association of Nurserymen (A.A.N.)

C. International Society of Arboriculture (I.S.A.) National Arborist Association (N.A.N.)

1.4 ENVIRONMENTAL REQUIREMENTS

A. Construct temporary erosion control systems as shown on Construction Drawings and in accordance with applicable County requirements to protect adjacent properties and water resources from erosion and sedimentation.

B. Contractor shall not begin construction without a eNOI permit governing discharge of storm water from site for entire construction period. eNOI permit requires Erosion Control Plan to be in place during construction.

C. Contractor shall be totally responsible for conducting storm water management practices in accordance with a eNOI permit and for enforcement action taken or imposed by Federal or State agencies, including cost of fines, construction delays, and remedial actions resulting from Contractor's failure to comply with provisions of eNOI permit.

1.5 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally 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.

E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.6 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.7 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.8 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or the District.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify Miss Utility before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

F. The following practices are prohibited within protection zones:

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

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

I. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 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 walkways, according to erosion- and sedimentation-control specific to the site that

complies with the District Standards and Specifications and Erosion and Sedimentation Control Field Handbook.

B. Inspect, maintain, and repair 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.

3.3 TREE AND PLANT PROTECTION

A. Protect existing trees, shrubs and bushes outside the limits of clearing and grubbing by fencing or barricading as required by the Urban Forester (DPRCR). Protect existing trees designated to be saved inside the limits of clearing and grubbing by methods approved by the Urban Forester (DPRCR), which may include tree protection fencing, root pruning, and/or protective matting.

B. Trees damaged by construction operations shall be evaluated by the Urban Forester (DPRCR) and replaced, pruned, and/or treated. Pruning or treatment must be performed by an International Society of Arboriculture (I.S.A) Certified Arborist.

C. Replace trees damaged beyond repair by the construction process with nursery grown stock meeting American Association of Nurserymen (A.A.N.) Standards. Trees shall be replaced per the County's tree replacement guidelines.

D. Protect property pipes, stones and monuments from damage. The Contractor will be responsible for replacing disturbed markers by a registered surveyor at no expense to the County.

E. Protect street, roads, historical objects, adjacent property, vegetation and other works to remain throughout the contract.

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

D. Removal of underground utilities is included in earthwork sections and with applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security and utilities sections.

3.5 CLEARING AND GRUBBING

A. Unless otherwise indicated on the Construction Drawings, remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
3. Use only hand methods for grubbing within protection zones.
4. Chip removed tree branches and stockpile in areas approved by Architect.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork 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.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth indicated on Drawings in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Dispose of trees and shrubs in accordance with the Garbage, Refuse and Weeds Ordinance of the District code. When approved by the Engineer, material may be dumped within the Contract area where directed.

C. Do not burn materials on the site. The County Fire Marshal may consider granting a waiver from open burning restrictions in cases where the State Air Pollution Control Board has granted a waiver to the Contractor or permit holder. The responsibility for obtaining all waivers shall be the Contractor’s or permit holders.

D. Remove material from the site as it accumulates. Do not allow waste material to accumulate for more than 48 hours.

END OF SECTION

SECTION 31 2000 – EARTH MOVING

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. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Sections:
1. Section 0155713 "Temporary Erosion and Sediment Control" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.

1.3 APPLICABLE SPECIFICATIONS

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

B. American Society for Testing and Materials (ASTM)

C. Occupational Safety and Health Act, State & Federal (OSHA)

D. DC Department of Transportation, Road and Bridge Specifications (DDOT)

1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill 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: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer 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.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 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 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom; measured according to SAE J-1179.

2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.

I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Geofoam.
4. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches.
2. Warning Tape: 12 inches long; of each color.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to [ASTM D 698] [ASTM D 1557].

C. Blasting plan approved by the District.

D. Seismic survey report from seismic survey agency.

E. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, which might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.7 QUALITY ASSURANCE

A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:

1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
2. Seismographic monitoring during blasting operations.

B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:

1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
2. Seismographic monitoring during blasting operations.

C. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.8 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Section 311000 "Site Clearing", are in place.

D. The following practices are prohibited within protection zones:

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

E. Do not direct vehicle or equipment exhaust towards protection zones.

F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

G. Underground Utilities: The location of existing utilities has been indicated on the drawings based on the best information available. The completeness or accuracy of the information is not guaranteed. Contractor shall notify "Miss Utility" in accordance with the provisions stipulated in the Underground Utility Protection Ordinance (Chapter 55), of the District's Code.

H. Overhead Utilities: The Contractor shall identify and protect all existing overhead utility poles and facilities in the vicinity of the Work. The Contractor will be solely responsible for all necessary notification and coordination with the utility owner(s). There will be no payment made for necessary bracing, sheeting, shoring, or other work required to protect and maintain existing utility poles or overhead utilities.

I. Existing Foundations: When foundations are located such that excavation may endanger or interfere with an existing structure or utility, the Contractor shall take all measures necessary to protect the existing utilities or structures. There will be no payment made for these measures.

J. Stability of Excavation: The Contractor shall be solely responsible for the stability of excavations and for meeting all State and Federal OSHA requirements. Provide all sheathing, lagging, bracing, and other support required to retain the stability of excavations.

K. Care and Restoration of Pavement and Property: When excavations are to be made in paved surfaces, the Contractor shall sawcut or use of a similar tool so as to provide a clean, uniform edge with a minimum of disturbance to remaining pavement. Pavement and other property outside of the defined Limits of Disturbance shall be preserved in the condition existent prior to construction. Damage or other impacts upon pavement or property outside the Limits of Disturbance shall be restored immediately at the Contractor's expense.

L. Construction Tolerance: Compact, shape, slope, and dress to yield the grades and slopes illustrated on the approved plans. In backfilled or other non-paved areas, grades shall be within 0.10 foot of the design grade. Slopes shall not be steeper than 2(H):1(V) and shall not deviate from a theoretical plane surface by more than 0.5 feet.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Refer to Geotechnical Report.

C. Unsatisfactory Soils: Refer to Geotechnical Report.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

J. Sand: ASTM C 33; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

L. Backfill: Backfill shall be free of vegetation, masses of roots, and stones over 3-inches in any dimension, frozen material, cinders, ashes, refuse, or porous matter. Organic matter shall not exceed minor quantities and shall be well distributed. In addition, Backfill shall be of such a nature and in such condition that it can be compacted to a dense and stable fill.

M. Top Soil:
1. Topsoil furnished by the Contractor shall consist of a natural friable surface soil without admixtures of subsoil, refuse, or foreign materials. It shall be reasonably free from roots, hard clay, coarse gravel, stones larger than 2 inches in any dimension, noxious weeds (including quackgrass rhizomes and the nut-like tubers of nutsedge), tall grass, brush, sticks, stubble, or other materials which would be detrimental to the proper development of vegetative growth.
2. Topsoil shall contain not less than 3% nor more than 10% organic matter by weight.

3. The Contractor shall submit per Section 01300 to the Project Officer a soil analysis describing the soil composition including pH factor and percentage of organic content prior to placing any Topsoil.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
4. Tear Strength: 56 lbf; ASTM D 4533.
5. Puncture Strength: 56 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 40, No. 60, or No. 70 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.5 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

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. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 LOCATION AND PROTECTION OF EXISTING STRUCTURES AND UTILITIES

A. Locate all utility pipes, conduits and facilities well ahead of the excavation process. Plainly mark all such locations and comply with the Underground Utility Protection Ordinance (Chapter 55), of the District's Code.

B. Where the Contractor has identified or anticipates existing utilities, structures, or artifacts, excavate using hand tools or other labor intensive activity as necessary to protect the facilities. No extra compensation or time will be allowed for this activity

C. In case of damage caused by the Work, notify the owner or appropriate agency or party and affect repair in a manner resulting in a condition at least equal to the condition prior to construction. No extra compensation or time will be allowed for repair of damages.

3.3 DEWATERING

A. At all times during construction – provide, place and maintain ample means and devices with which to remove promptly all water entering trenches and other excavations. Keep excavations dry until the structures, pipes, and appurtenances to be built therein have been completed and backfilled. Dispose of all water pumped or drained from the work without impact to the Work, traffic, or injury to public or private property, and in compliance with all Local, State, and Federal regulations.

3.4 EXPLOSIVES

A. Explosives: Do not use explosives.

B. Explosives: Obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.

1. Perform blasting without damaging adjacent structures, property, or site improvements.
2. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.

3.5 TRENCH EXCAVATION

A. Carry out the excavation, dewatering, sheeting, and bracing in such manner as to eliminate any possibility of undermining or disturbing the foundations of any existing structure, utility, facility, or any work previously completed.

B. Excavate pipe trenches to the necessary depth as shown on the drawings, holding the width below top of pipe as shown in the Standard Details.

C. the Contractor shall comply with all OSHA and/or other applicable regulations for excavation.

D. Excavate trenches to provide a uniform and continuous bearing and support for the pipe and appurtenant structures on solid and undisturbed ground and at the specified grade at every point.

E. Correct any part of the trench bottom excavated below the specified grade with approved materials and thoroughly compact. Shape the bottom of all pipeline trenches to fit the lower part of the pipe exterior for a width of a least 60% of the pipe breadth. Shape the excavation and/or bedding for pipe bells, joints, and fittings. Care shall be taken that stones and lumps shall not become nested.

F. Should an unacceptable bedding for the proposed pipe or structure be encountered, notify the Engineer. The Engineer may direct additional excavation below the bottom of the proposed pipe or structure and direct the contractor to provide an alternate bedding or foundation. Additional excavation due to the fault or negligence of the Contractor or without prior approval from the Engineer shall be remedied at the expense of the Contractor.

3.6 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. 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 bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
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.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

3.7 Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.8 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Refer to Geotechnical Report for subgrade inspection and preparation.

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 Architect, without additional compensation.

3.9 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 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF HANDLING AND DISPOSAL OF EXCAVATED MATERIALS

A. Carefully remove loam and topsoil to be incorporated in the finished work and store separate from the other excavated material. Failure to isolate loam and topsoil from the other excavations shall require that said soils not be used as topsoil.

B. Excavation shall include the disposal of material deemed unsuitable by the Project Officer for reuse in the Work. The Contractor shall stockpile, treat, and/or otherwise manipulate suitable materials which may be incorporated into the project at a later date or different location. The Contractor is responsible for protecting any stockpiled material from contamination by unsuitable material and from degradation by any other means. Failure by the Contractor to adequately handle and protect excavated material will result in the Contractor being directed to use Select Borrow or other approved material at no expense to the County. Unless otherwise specified, the Contractor will be solely responsible for securing the necessary area for stockpiling, treating, protecting, and related activities.

C. Do not mix pavement with other excavated material. Dispose of excavated pavement away from the work site immediately. All costs associated with removing, handling, transporting, di posing, etc. of existing pavement, curb and gutter, sidewalks, driveway aprons, etc. is considered to be incidental to Excavation and no additional compensation will be considered for such activities.

D. All materials deemed unsuitable for use in the Work by the Project Officer shall be disposed of by the Contractor at his own expense. Storing, transporting, loading, handling, treating, and other associated costs are considered to be incidental to the Work and no additional compensation will be considered for such activities.

E. The County shall take preference over others in claiming excavated material. The Contractor shall consult the Engineer before disposing of such materials.

F. If space is available at the County's Trades Center, the Contractor may be directed to dispose of clean excavated asphalt and/or unreinforced concrete pavement there, at no

cost to the Contractor or the County. If space is not available at the Trades Center, the Contractor will be responsible for alternate disposal arrangements. No additional compensation will be made if the Trades Center does not have adequate space to accommodate materials from the project.

3.11 BACKFILL – GENERAL

A. If the Project Officer determines that sufficient approved material from excavation on the job-site is not available for backfill, the Contractor shall secure material from areas outside the job-site to complete the backfill.

B. All backfill materials shall contain sufficient moisture for proper compaction.

C. Except in proposed landscape areas, or where otherwise specified, each layer of material shall be compacted to a dry density not less than 95 percent of the maximum determined by the Modified Proctor Compaction Test. Upon completion of backfilling in any area under the contract, the Owner may make tests to determine the degree of compaction of the backfill material. If the results of test indicate densities less than specified, the Contractor shall, at his own expense, remedy the condition as directed, in such portions of the trenches as may be required.

D. Backfill all excavations as rapidly as practicable after the completion of each section of the work. All unauthorized excavations made by the Contractor shall be immediately backfilled at the Contractor's expense. Complete all backfilling to the dimensions and levels shown on the drawings.

E. The placement of material around structures shall be carried out symmetrically around the structure in horizontal lifts not to exceed six inches of loose material. The Contractor shall protect, and be responsible for any damages to adjacent structures or utilities.

F. Start backfilling around concrete structures only after the concrete has reached sufficient strength to withstand the pressure exerted by the material and compacting equipment and after carrying out and satisfactorily completing the tests specified in Section 03100, Concrete Formwork, Reinforcement and Materials.

G. At points which cannot be reached by mobile mechanical equipment, use suitable power driven tampers to achieve the same degree of compaction.

H. No material shall be placed or compacted when it is wet or frozen or when the sub grade or previously placed material is wet or frozen.

3.12 UTILITY TRENCH BACKFILL

A. The sub grade shall be properly shaped before any material is placed and compacted. Care shall be taken that stones and lumps shall not become nested.

B. Place backfill material in six-inch layers to a point at least two feet above the pipe crown. Thoroughly compact each layer for the full trench width and under, around, and over the pipe, using hand-operated mechanical tampers exerting a pressure of not less than 250 foot pounds per square foot of tamping force. The contractor will be responsible for pipe damage as a result of excessive tamping force.

C. Remainder of trench, more than two feet above pipe crown, may be backfilled by machinery in one-foot layers, thoroughly compacted.

3.13 FINAL GRADING AND TOP SOIL

A. Prior to placement of topsoil, the subgrade shall be disced or rototilled to a minimum depth of 2 inches.

B. Topsoil shall be uniformly distributed in a 4-8 inch layer and lightly compacted to a thickness of 4 inches (or as indicated on the plans) using a cultipacker, roller, or other approved equipment weighing 100-160 pounds per linear foot of roller.

C. Topsoil shall not be placed when either the topsoil or the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to proper grading.

D. Final grading shall not permit ponding of water.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

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 by 2 percent and is too wet to compact to specified dry unit weight.

3.15 FILL OR EMBANKMENT

A. Fill or embankment above existing grade shall consist of the placing, shaping, and compaction of approved Backfill material as illustrated on the approved plans.

B. Concrete foundations, slabs, rocks, boulders, and similar material removed during excavation may be utilized in embankments when said material will be located five feet or more below the proposed subgrade surface. When such materials are used, they shall be fractured into pieces such that no dimension exceeds 18 inches in any dimension or plane. The Contractor shall take care to ensure that no voids develop, and will be held responsible for any surface settlement resulting there from.

C. The embankment material shall be uniformly compacted throughout in lifts of no more than 12 inches, except in the case of rock, where lifts of up to 2 feet may be used. Except as otherwise allowed in the paragraph above, the embankment material shall conform to the requirements of Backfill. Each layer shall be compacted at optimum moisture content and the embankment shall have the required maximum density of ninety five percent (95%) as compared to the density of the same material when tested in accordance with AASHTO T- 99.

D. Do not place embankment upon frozen ground or areas covered with snow or ice or saturated soils.

E. The area upon which embankments are to be placed shall be denuded of vegetation per Section 02100.

F. Compact the ground upon which the embankment will be constructed to a depth of 8 inches prior to placing any fill material.

G. Embankments to be constructed over swampy areas may be deposited by end dumping the original course. This course may exceed 8”, but shall be the minimum depth required to support the equipment and shall be determined by the Engineer. The use of compaction equipment will not be required on the original course.

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 D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 85 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 Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

4. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.18 SUBSURFACE DRAINAGE

A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer [to 85 percent of maximum dry unit weight according to ASTM D 698] [with a minimum of two passes of a plate-type vibratory compactor].

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer [to 85 percent of maximum dry unit weight according to ASTM D 698.
2. Place and compact impervious fill over drainage backfill in 6-inch- thick compacted layers to final subgrade.

3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches or less in compacted thickness in a single layer.
3. 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.
4. 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 D 698.

3.20 TESTS AND TESTING

A. The optimum moisture content and the maximum density of each type of material used for structural fill and backfill shall be determined by “Standard Test Methods for Moisture Density Relations of Soils and Oil- Aggregate Mixtures Using 5.5-lb. Rammer and 12-inch Drop (ASTM D698) or (AASHTO T-99)”.

B. The field moisture content of materials being compacted shall be determined by “Laboratory Determination of Moisture Content of Soil,” (ASTM D2216). The field density of compacted material shall be determined by either “Standard Test Method for

Density of Soil in Place by Sand Cone Method," (ASTM D1556) or- "Standard Test Method for Density of Soil in Place by the Rubber Balloon Method," (ASTM D2167).

C. Perform sufficient field density and field moisture content tests on each lift of material to ensure the Engineer that the requirements of this Section of the Specifications are compiled with.

D. State when and where the tests are to be made so that the Engineer may observe the testing. Submit certified reports verifying test results. The Engineer may order more testing should he feel the above procedures to give inadequate information, or if he feels the results of such testing to be questionable

3.21 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 Architect; reshape and recompact.

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. Maintenance of backfilled excavations.

1. The Contractor shall maintain the backfilled area in proper condition for a period of one year after final acceptance of the project. All defects shall be promptly corrected. If the Contractor fails to do so within a reasonable time after the receipt of written notice from the Engineer, the County may correct any dangerous condition at the Contractor's expense.
2. The Contractor shall be responsible for any injury or damage that may result from improper maintenance of trenches at any time previous to the end of the aforementioned guarantee period.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 32 1313 – CONCRETE PAVING

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. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walkways

    a. Color Concrete Pavement
    b. Special Finishes
    c. Natural Color Concrete Pavement

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:

1. Exposed Aggregate: 10-lb Sample of each mix.

C. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

2. The Concrete Plant shall provide the concrete mix design and certified test reports on the aggregate, admixture, cement, and curing materials to be incorporated in the concrete for the project.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer of detectable warnings, ready-mix concrete manufacturer, and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

C. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

D. ACI Publications: Comply with ACI 301M (ACI301) unless otherwise indicated.

1.7 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.

2. Forms shall conform to VDOT Section 403.03.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn galvanized steel wire into flat sheets.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

D. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.

E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

F. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.

G. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.

H. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

I. Plain-Steel Wire: ASTM A 82/A 82M, as drawn galvanized.

J. Deformed-Steel Wire: ASTM A 496/A 496M.

K. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain deformed.

L. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

M. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain-steel bars.

N. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

O. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

P. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

Q. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

R. Zinc Repair Material: ASTM A 780.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout the Project:
1. Portland Cement: ASTM C 150, white Portland cement Type I.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S, Class 4M, Class 1N, uniformly graded. Provide aggregates from a single source.
1. Maximum Coarse-Aggregate Size: 1-inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:

1. Aggregate Sizes: ¾ to 1 inch, ½ to ¾ inch, 3/8 to 5/8 inch nominal.
2. Aggregate Source, Shape, and Color: Match existing.

2.4 JOINT FILLER

A. Joint filler shall be ½-inch perforated asphalt expansion joint material conforming to ASTM D994 or ASTM D 1751.

2.5 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301M (ACI 301), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixures to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28 Days): 3500psi
   2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.49
   3. Slimp Limit: 3 inches, plus or minus 1 inch

2.6 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.

   1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

   1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
   2. For concrete batches larger than 1 cu. yd, increase mixing time by 15 seconds for each additional 1 cu. yd.
   3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving 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 pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides 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. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to require 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 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 reinforcement 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. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

G. 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 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges 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 paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.

4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. 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, to match jointing of existing adjacent concrete paving:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch, 3/8-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

    a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

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.

    a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.

F. Expansion Joint: Preformed expansion joint for use in PCC pavement, base, sidewalk, curb and gutter construction and sewer-water structures shall meet the requirements of AASHTO M 153, Type II (Cork). Preformed joint material shall be new material for all Work and furnished in longest lengths practicable for intended use as determined by the Engineer, and in no case shall joint material be furnished in lengths less than 10 feet. Pieces for curb and gutter and as directed shall be cut in exact size from larger furnished sections. All splices in joint material shall be carefully made to insure against penetration

of PCC between adjacent strips of joint material. Joint material shall neither be furnished nor stored in rolls. When dowel bars or other approved load transfer devices are specified, the preformed filler shall have holes of the proper diameter or size drilled through it at the specified intervals to receive the bars and to insure a tight fit

3.6 CONCRETE PLACEMENT

A. Before placing concrete, remove all construction debris, water and ice from the places to be occupied by the concrete. Give particular attention to the removal of dirt and debris from all formed construction joints.

B. Concrete, when deposited, shall have a temperature ranging between a minimum of 50 degrees Fahrenheit and a maximum of 90 degrees Fahrenheit. When the temperature of the surrounding air is below 50 degrees or above 90 degrees Fahrenheit, concreting shall be done in accordance with the recommendations noted in ACI-306 and ACI-305 respectively.

C. Mix concrete in such quantities as required for immediate use and place prior to loss of slump. Do not retemper concrete.

D. Spade, work and vibrate concrete as it is being poured, to secure its maximum density, free from voids and completely filling the forms. Thoroughly work concrete to secure the complete envelopment of all parts of the reinforcing steel and completely fill the corners of the forms. Maintain not less than 2 approved vibrators on the work at all times. Use tremies or chutes for drops of more than 5-feet.

E. Fill under Slabs on Grade: Clean sand, or aggregate, evenly spread and compacted to the full depth, unless otherwise shown on the Contract Drawings.

F. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

G. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

H. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F , uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg 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 design mixtures.

I. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to 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 in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and 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. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 SPECIAL FINISHES

A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:

1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

B. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of 1/16 inch.

1. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. of dampened, slip-resistive aggregate over paving surface in two applications. Tamp aggregate flush with surface using a steel trowel, but do not force below surface.
2. Uniformly distribute approximately two-thirds of slip-resistive aggregate over paving surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second slip-resistive aggregate application, uniformly distributing remainder of material at right angles to first application to ensure uniform coverage, and embed by power floating.

3. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
4. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Curing shall be started as soon as it is possible to apply the curing medium without damaging the surface, preferably immediately upon completion of the finishing operation.

C. Curing shall continue uninterrupted for a minimum period of 14 days. Rapid drying upon completion of the curing period shall be prevented. At no time during the curing period shall the temperature of the concrete be permitted to drop below 40 degrees Fahrenheit.

D. Comply with ACI 306.1 for cold-weather protection.

E. 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.

F. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:

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, 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 occurring during installation or 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 that have been

subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/2 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.11 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal.

3.12 SAMPLING, TESTING AND ENFORCEMENT

A. Retain first paragraph below to identify who shall perform tests and inspections. If retaining second option, retain "Field quality-control reports" Paragraph in "Informational Submittals" Article.

The Contractor shall furnish such facilities as the Engineer may require for onsite testing and for collecting and forwarding concrete samples for testing to an approved independent laboratory selected by the Engineer. The laboratory shall for each 10 cu. yds. of concrete. The laboratory shall maintain records showing brand of cement, brand and quantity of admixtures, time and location of the batch from which the test was made, air content, slump, and compressive strength. The laboratory shall supply the test cylinders, slump cones, field technicians, and all equipment necessary for performance of field and laboratory testing specified herein.

B. One strength test shall consist of four field specimens. One (1) specimen for testing at seven (7) days, one (1) specimen for testing at fourteen (14) days, and two (2) specimens for testing at twenty-eight (28) days. The samples for strength tests shall be taken in accordance with –"Method of Sampling Fresh Concrete" (ASTM C-172). Cylinders for acceptance tests shall be molded and laboratory-cured in accordance with "Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field" (ASTM C-31) and tested in accordance with "Method of Test for Compressive Strength of Molded Concrete Cylinders" (ASTM C-39). Each strength test result shall be the average of two cylinders from the same sample tested at seven (7), fourteen (14) and twenty-eight (28) days.

C. When the frequency of testing will provide less than five strength tests for a given class of concrete, make tests from at least five randomly selected batches or from each batch if fewer than five are used. When the total quantity of a given class of concrete is less than 30 cu. yds., the strength tests may be waived by the Engineer if, in his judgment, adequate evidence of satisfactory strength is provided.

D. Should individual tests of laboratory-cured specimens produce results more than 500 psi below specified strength (f'c), or tests of field-cured cylinders indicate deficiencies in protection and curing, take steps to assure that load carrying capacity may have been significantly reduced, tests of cores taken from the area in questions shall be required in accordance with "Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete" (ASTM C-42). Three cores shall be taken for each cylinder test more than 500 psi below specified strength (f'c). If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be immersed in water for at least 48 hours and tested wet.

E. Concrete represented by the above core tests will be considered structurally adequate if the average of the three cores is equal to at least 85 percent of specified strength (f'c) and if no single core is less than 75 percent of f'c. To check testing accuracy, locations represented by erratic core strengths may be retested. If these strength acceptance criteria are not met by the core tests, and if structural adequacy remains in doubt, the Engineer shall order load tests for the questionable portion of the structure, or declare the section to be defective.

3.13 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Defective concrete is defined as concrete in place which does not conform to strength, shapes, alignments, appearance, and/or elevations as shown on the drawings; areas which contain faulty surface areas and/or concrete surfaces not finished in accordance with these specifications.

C. Remove all defective concrete and replace in a manner meeting with the Engineer's approval. Should only surface imperfections occur, patch at the discretion of, and in a manner satisfactory to, the Engineer. Permission to patch the work shall not be considered as a waiver of the County's right to require complete removal and replacement of such defective work should the patching fail to satisfactorily restore the required quality and appearance of the work.

D. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

E. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

F. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 323213 – FENCES AND GATES

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. Welded or Crimped wire or rod mesh assemblies.
   2. Welded or Crimped wire or rod mesh doors and gates.
   3. Cast-in-place anchors required for installation.
   4. Animal Transfer door assemblies:
      a. Animal enclosure fences
      b. Swing gates
      c. Horizontal sliding gates.
      d. Cover panels and plates.
      e. Locking/latching mechanisms.
      f. Miscellaneous shop fabricated operating hardware and steel shapes.

B. Related Sections:

   1. Division 01 for general requirements for caging work, including responsibilities of a single-source caging specialist; and coordination requirements with the Animal Management personnel.
   2. Division 03 Section "Cast-in-Place Concrete" for building anchors into concrete construction.
   3. Section 055964 Metal Welded Mesh Enclosures for building and fencing mesh fabrics.
   4. Section 055965 Vertical sliding gates and panels (guillotines).
   5. Section 099600 High-Performance Coatings for finish of metal posts, railings and frames.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for detention enclosures.

B. Shop Drawings: For all fences and gates. Include plans, elevations, sections, details, and attachments to other work.

1. Indicate location, plan, and dimension of each fence and gate type.
2. Indicate type of steel for each fence and gate component.
3. Show elevations of each fence type and indicate location, dimensions, door swing/slide direction, details of mesh/cedar/composite lumber, door hardware and accessories, and preparations for control systems.

C. Qualification Data: For qualified Fabricator and Installer.

D. Engineer's Calculations:

1. Provide structural analysis to comply with the design loads of 'Exposure Category C' as indicated by DC Building Code, Chapter 16 Structural Design. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation to satisfy code requirements.

1.4 QUALITY ASSURANCE

A. Fabricator and Installer Qualifications:

1. Only Subcontractors whose experience and workmanship have been previously reviewed and pre-qualified by the COTR/Exhibit Designer for the Work of this Section. Qualifications for companies not listed herein shall include a minimum of ten (10) years experience in metal work of this type, plus a minimum of three (3) similar projects involving containment of animals. Companies requesting consideration shall submit written and photographic proof of previously performed projects together with the contact name and phone number of the project COTR lead maintenance and operations person.
2. Subject to compliance with the specified requirements, pre-qualified mesh suppliers:
   a. Nets Unlimited, Inc.: 20625 North 29th Place, Phoenix, AZ 85050, telephone: (480) 515-1300.
3. Subject to compliance with the specified requirements, pre-qualified animal transfer door assemblies, fabricators and installers:
   a. Fauna Research, Inc., 8W Bard Ave, Red Hook, NY 12571, telephone: (845) 758-2549

B. Source Limitations for Fences and Gates: Obtain each type of steel mesh used in the fences and gates from single source, single manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

D. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with fences and gates by field measurements before fabrication.
   1. Prior to submission of shop drawings, the Fencing Contractor shall verify that all field measurements are as indicated on Drawings and Schedules, and notify the COTR in writing of any major discrepancies. No fabrication shall proceed until all inconsistencies are corrected.
   2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions. Fencing not fitting the conditions as detailed and specified shall be rejected and replaced at no cost to the COTR-Smithsonian Institute.

1.6 COORDINATION

A. Coordinate installation of anchorages for all fence and gate poses. 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 adjacent construction. Deliver such items to Project site in time for installation.
   1. Coordinate with concrete, shotcrete, and masonry trades for installation details required.

1.7 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. Security Fasteners: Furnish not less than one box for every 50 boxes or fraction thereof, of each type and size of fastener installed.
   2. Tools: Provide two sets of tools for installing and removing security fasteners.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Mild Steel Plates, Shapes, and Bars: ASTM A 36.

B. Cold-Rolled Steel Sheet: ASTM A 1008, CS (Commercial Steel), Type B, suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A 1011, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A 653, CS (Commercial Steel), Type B; with G90 zinc (hot-dip galvanized).
   1. Steel Cover Plate: 10-gauge steel sheet, pre-drilled for fasteners prior to galvanizing.

E. Steel Tubing: ASTM A 501 or ASTM A 513, Type B unless otherwise indicated. Galvanized after welding typical.

F. Steel Sections: ASTM A236, galvanized after welding typical.

G. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240, austenitic stainless steel, Type 304.

H. Stainless-Steel Bars and Shapes: ASTM A 276, Type 316L

I. Standard Fasteners: Exposed Mechanical Fastenings: Flush countersunk torx or hex socket machine screws and bolts; stainless steel finish; unobtrusively located; consistent with design of component, except where specifically noted otherwise. Fasteners, Bolts, Nuts, and Washers: ASTM A325. All bolts, machine screws and fasteners shall be A316 stainless steel.

J. Concealed Bolts: ASTM A325, A316 stainless unless otherwise indicated.

K. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.2 WOVEN-ROD-MESH AND WOVEN WIRE ASSEMBLIES

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. Cable Design, Wilmette, Illinois, (847) 256-9813, or approved equal.

B. Woven Wire, and Woven Rod Mesh: Intermediate-crimp wire or double crimped rod, square pattern, woven-wire mesh, made from wire complying with ASTM A 510.
   1. Welded Wire Mesh
      a. Mesh size: 2” x 2” x 6 gauge
      b. Zinc-Coated Fabric: ASTM A 392, Type II, Class 2, 2.0 oz./sq. ft. with zinc coating applied after welding.
   2. Woven Wire Mesh
      a. Mesh size: 2” x 2” x 6 gauge

b. Zinc-Coated Fabric: ASTM A 392, Type II, Class 2, 2.0 oz./sq. ft. with zinc coating applied after welding. Painted black

C. Main Framing: As detailed.

D. Supplementary Framing: As detailed and/or specified.

E. Braces: Formed from same material as main framing.

F. Floor Anchor Clips and Anchors: as detailed.

G. Cords and Control Wires: Galvanized steel.

H. Cable: 1/8" diameter, stainless steel aircraft cable composed of 7 strands of 19 wires per strand (7 x 19), 1700 lb. break strength minimum, uncoated, with accessory end fittings as manufactured by Cable Design, Wilmette, Illinois, (847) 256-9813, or approved equal. Routing and length as indicated for proper operation and with associated fittings.

J. Cabled counterweight assemblies: Adjustable counterweight fully contained, except for handle clearance, by steel channels for the length of counterweight travel. Cables shall be run within galvanized steel sleeves, bent plates, or pipes between sheave assemblies.

K. Non counterweight cable operation assemblies: Fully contained cables run within hot dipped galvanized steel sleeves, bent plates, or pipes between sheave assemblies.

L. Sheaves: Covered assembly with nylon sheaves and accessible bronze bearings for lube required. Wheel shall be fully contained, except for cable entry and exit, in a galvanized steel box with clear 1/4 inch thick polycarbonate removable cover. Removable cover fasteners shall be countersunk, flat head type.

M. Mesh/Cedar Plank Gates.
   a. Frame: As detailed, mitered and welded continuously.
   b. Coordinate to provide hinges as detailed.

N. Mesh Gates.
   1. Mesh and steel frames as detailed.
   2. Coordinate to provide hinges as detailed.

O. Cedar Plank Gates – used in locations visible by the Public, see drawings for locations
   a. Frame: As detailed, mitered and welded continuously.
   b. Coordinate to provide hinges as detailed.

2.3 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. 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. Coordinate dimensions and attachment methods of detention enclosures with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Form and grind edges and corners to be free of sharp edges or rough areas.

D. Form metal in maximum lengths to minimize joints. Form sheet-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

E. Weld corners and seams continuously to comply with referenced AWS standard and 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. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
5. Obtain fusion without undercut or overlap.
6. Finish exposed welds and surfaces smooth and blended at exposed connections so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
7. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention enclosures rigidly in place and to support indicated loads. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.

G. Attach latches and other hardware enclosures as indicated.

H. Form exposed work true to line and level with accurate angles, surfaces, and straight sharp edges.

I. Form exposed connections with hairline joints flush and smooth using concealed fasteners where possible. Use exposed security fasteners of type indicated or, if not indicated, flat-head (countersunk) security screws. Locate joints where least conspicuous.

J. Fencing with welded connections: Allow for thermal movements from ambient and surface temperature changes. 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.

2.4 GATE HARDWARE

A. Provide as specified or approved equal.
   1. Refer to drawings for design intent.

B. Hinges: as indicated in drawings, or detail callout, or by door hardware schedule for specific door application.

C. Latches:

   1. Gates: When specified, detailed, or scheduled, two-sided keeper side gate latch bolts shall be stainless steel, min. 5/16" in thickness and capable of withstanding a 900 pound force from animal pressure. It must provide the ability to be padlocked in both the open and closed positions on the keeper side of the gate. On the animal side, the latch is a swinging 1/2” thick notched plate steel capable of providing temporary closure of the gate by the keeper from within the animal enclosure.

D. Padlocks:

   1. Padlocks shall accommodate Schlage small format interchangeable seven pin cores. Padlocks shall be 5/16" shackle diameter, shackle length as required (minimum 1-1/2" shackle length). Provide a padlock for every padlock tab lock location indicated on the Drawings and/or as scheduled.
   2. Provide owner with sample padlock for confirmation and approval prior to ordering.

E. Sliding Door/Gate:

   1. Richards Wilcox or approved equal, 232 Series galvanized track/roller assembly and accessories.
      a. Side wall mounting brackets: 0232 center and end blank.
      b. 2321.00003 track.
      c. 2321 truck/apron assembly.
      d. .0572 end stop.
      e. 0514.00038 heavy duty spring bolt.
      f. Remote cable operation typical in both directions from keeper corridor.

F. Substitutions: All substitutions for the hardware of this Section must be reviewed and approved by the Exhibit Designer and COTR prior to Bid acceptance.

G. Keying: Coordinate all keying with the COTR and the requirements of Division 08, Door Hardware Descriptive in the specifications for the overall Project.

H. Hardware Finishes: All hardware shall be finished to the requirements of Division 08, Hardware Descriptive.

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 fence and gates.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of detention enclosure connections before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of fences and gates.

D. Inspect built-in and cast-in anchor installations, before installing fences and gates, to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
2. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

E. Verify locations of fences and gates with those indicated on Shop Drawings.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install all fences and gates plumb, rigid, properly aligned, and securely fastened in place, complying with manufacturer's written recommendations.

B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing fences and gates to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.

C. Cutting, Fitting, and Placement: Obtain manufacturer's written approval for cutting, drilling, and fitting required for installing fences and gates. Set fences and gates accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels. Minimum barrier heights must be maintained across the sloping Management Yard.

D. Provide temporary bracing or anchors in formwork for items that are to be built into adjacent construction.

E. 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.

F. 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. Finish exposed welds and surfaces smooth and blended at exposed connections so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.3 FIELD QUALITY CONTROL

A. COTR shall review installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Remove and replace fencing and gate work if inspections indicate that work does not comply with specified requirements. Remove malfunctioning units; replace with new units. All gates, and guillotines shall operate smoothly, quietly, and without binding.

C. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

D. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

3.4 CLEANING AND PROTECTION

A. Clean field welds, bolted connections, and abraded areas.

END OF SECTION 055963

SECTION 328400 - IRRIGATION

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. Additionally, the following Sections apply:

1. Section 329115 - Soil Preparation
2. Section 329200 - Turf and Grasses
3. Section 329200 - Plants

1.2 SUMMARY

A. Section Includes:

1. Piping.
2. Sleeving
3. Manual valves.
4. Automatic control valves.
5. Miscellaneous piping specialties.
6. Sprinklers.
7. Quick couplers.
8. Controllers.
9. Boxes for automatic control valves.

1.3 DEFINITIONS

A. Lateral Piping: Downstream from control valves to sprinklers and specialties. Piping is under pressure during flow.

B. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 PERFORMANCE REQUIREMENTS

A. Irrigation zone control shall be automatic operation with controller and automatic control valves.

B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent (head-to-head) irrigation coverage.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated, submit complete materials list prior to performing any work. Submit four (3) copies of manufacturer catalog data ("cut sheets").

B. Record ("As-Built") Drawings: Drawn to scale on clean bond copy, showing "red line" notes and final locations of all equipment installed. Show critical measurements to the location of all valve boxes, sleeve-ends, main line routing, control wire routing, etc. Provide four (3) copies. Above-ground temporary irrigation items are not required to be shown on the record drawings.

C. Qualification Data: For qualified Installer.

D. Zoning Chart: Show each irrigation zone and its control valve.

E. Controller Timing Schedule: Indicate timing settings for each automatic controller zone for base schedule. Show base schedule for established plantings.

F. Operation and Maintenance Data: A complete maintenance and operations manual shall be prepared by the Contractor and three copies of the manual shall be turned over to the Owner's Representative at the final inspection. The manuals shall consist of three ring binders containing: (1) catalogs of all materials used, (2) a complete parts list of all materials, (3) a written summary of all operations data including spring start-up and winterization techniques, controller programming, valve cleaning, irrigation adjustments, backflow preventer operation and any other information required to operate and maintain system, (4)contact information for two local distributors. Provide three (3) copies in three-ring binders.

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

1. Spray Sprinklers: Provide five (5) extra sprinklers of each size installed, including five (5) each of each kind of nozzle installed.

H. The contractor shall provide the Owner's Representative with the necessary keys and/or other tools necessary to operate/drain/activate the system.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Contractor must be a Washington State licensed landscape contractor. The irrigation system must be installed under the direct supervision of a journey irrigation mechanic or journey plumber with at least five (5) years field experience in the installation of irrigation systems of similar scope and size.

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. Irrigation equipment, pipe, fittings, and appurtenances: All specified equipment to be in brand new, unused condition.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Provide a locked, secure area for materials and equipment storage.

B. Deliver piping in standard twenty (20) foot lengths. Avoid dropping or otherwise mishandling the pipe.

C. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending, and protect from vehicular traffic or any other potential for damage or vandalism.

1.8 PROJECT CONDITIONS

A. Underground utilities and elements: Locate all underground utilities and elements prior to digging and/or driving stakes. Take care, to neither disturb nor damage any existing above ground or underground utilities or elements. Keep streets, sidewalks and site clean, free from debris and affected drains open and free flowing at all times. Engage the services of a private utilities locating service for location of utilities within the site.

B. Site inspection and layout: Before proceeding with any work, the Contractor shall inspect the site, carefully check all grades and verify all dimensions and conditions affecting the work to satisfy him/her that he/she may safely proceed. Changes or alterations to the system to meet actual conditions shall be made at the Contractor's expense. Irrigation plan is diagrammatic and is not intended to show exact locations of existing or proposed piping, valves or controllers. Locate new items as closely as possible to related curbs, walls, fences or edges of paving. Pipelines shown parallel on drawing may be placed in a common trench but separated by at least four (4) inches. Sprinkler heads are shown accurately and shall be installed as indicated by center of symbol.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

B. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

C. Hard Copper Tube: ASTM B 88, Type M, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

A. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedule 40; and ASTM 1220 SDR21 Class 200

1. PVC Socket Fittings: ASTM D 2466, Schedule 40
2. PVC Threaded Fittings: ASTM D 2464, Schedule 40. All nipples shall be Schedule 80.
3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.

B. Main line and laterals shall be Schedule 40 PVC pipe.

C. Sleeving: Sleeving shall be white Schedule 40 PVC pipe, 2x the diameter of the interior pipe. Pipes may share sleeves, provided the sum of the interior pipe diameters do not exceed 2X the diameter of the sleeve. Provide separate sleeve for control wires.

2.2 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656. Primer shall be Weld-On P-70 purple, and cement shall be Weld-On 711 gray for the main lines, and Weld-On 721 blue for the laterals.

C. Use Teflon tape for all threaded connections.

2.3 MANUAL VALVES

A. Bronze Gate Valves:

1. Install per Plans and Details

2.4 AUTOMATIC CONTROL VALVES

A. Per Plans and Details

B. Use Teflon tape only at threaded connections.

2.5 BACK FLOW PREVENTION DEVICE

A. Reuse existing

B. Coordinate with MEP for location and installation.

2.6 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Harvel Plastics, Inc.
b. Spears Manufacturing Company.
c. Or approved equal

2. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-socket end.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating non-conductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Epco Sales, Inc.
    d. Hart Industries International, Inc.
    e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    f. Zurn Plumbing Products Group; Wilkins Water Control Products.

2. Description: Factory-fabricated union, NPS 2 and smaller.

    a. Pressure Rating: 150 psi minimum at 180 deg F
    b. End Connections: Solder-joint copper alloy and threaded ferrous

2.8 MISCELLANEOUS PIPING SPECIALTIES

A. Pressure Gauges: ASME B40.1. Include 4-1/2-inch diameter dial, dial range of two times system operating pressure, and bottom outlet.

2.9 SPRINKLERS

A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.

B. Per Plans and Details

2.10 QUICK COUPLERS

A. Per Plans and Details

2.11 CONTROL WIRE

A. Control wire shall be insulated single strand copper designed for twenty (20) to fifty (50) volts and UL approved as Type U.F. (Underground Feeder). The UL and U.F. designations shall be clearly marked or indented on the insulation jacket of the wire. Use 14AWG wire.

B. Looped wires shall be provided within four (4) feet of each wire connection to solenoid. Control wires shall also be snaked underneath mainlines to allow “slack” in the lines.

C. Use white for the common wire, red for the signal wires, and orange for spares.

2.12 CONTROLLER

A. Reuse existing

2.13 BOXES FOR AUTOMATIC CONTROL VALVES

A. Plastic Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Carson Industries LLC.
b. Rain Bird Corporation
c. Or approved Equal

2. Description: Box and locking cover, with open bottom and openings for piping; designed for installing flush with grade. Boxes to be purple non-potable and marked “Irrigation Control Valve,” or “ICV.”

a. Automatic Control Valves: Use Standard (1419-12) rectangular valve boxes for one (1) inch control valves and Jumbo (1220-12) boxes for one-and-a-half (1-1/2) inch valves and drip control zone kits. Use extensions as needed. One valve per box.
b. Gate Valves: Use ten (10) inch round boxes with extensions as needed.
c. Quick-coupler Valves: Use ten (10) inch round boxes with extensions as needed.

B. Concrete Valve Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Oldcastle Infrastructure
b. Fogtite
c. Christy’s
d. Or approved equal
2. Concrete boxes shall have mouse-holes or knock-outs on all four sides.

C. Drainage Backfill: Washed drain rock 1/2” - 3/4”; three (3) inch minimum depth. Line all valve boxes with filter cloth to prevent soil intrusion. See Details.

2.14 OTHER SUPPLIES

A. Electrical tape shall be black plastic, three-quarters inch (3/4") wide and a minimum of 0.007 inches thick and the all-weather type.

B. Teflon tape shall be used for all threaded connections. Tape shall be set back a minimum of one quarter inch (1/4") into the pipe threading. Do not use pipe dope.

C. Encapsulate all splices with 3M DBY/R splice kits.

2.15 IDENTIFICATION

A. Underground - Type Plastic Line Markers (Detect-a-Tape): Permanent, bright-colored, continuous-printed plasticized aluminum tape, intended for direct-burial service; not less than 3" wide x 5 mils thick and shall be placed directly over the pipes at 6” below finished grades. Provide blue tape with black printing reading "CAUTION IRRIGATION LINE BURIED BELOW". Line Tec. Inc., PO Box 67, Glen Ellyn, IL 60138. Detectable Marking Tape; Allen Systems, P.O. Box 33569, Houston, TX 77233 (713)943-7213, (800) 231-2077; or Magnatec by Thor Enterprises, Inc. P.O. Box 450, Sun Prairie, WI 53590.

B. Christy’s identification tags manufactured from polyurethane Behr Desopan, incorporating an integral attachment neck and reinforced attachment hole and will be capable of withstanding 180 pounds pull force. Tag shall be 2 1/4” x 2 3/4” in size. All lettering shall be hot stamped in black and capable of withstanding outdoor use. Tag color shall be yellow. Marking tag shall be double side stamp with zone valve number

2.16 BACKFILL MATERIAL

A. Suitable bedding material for use around all pipes and equipment shall be: native topsoil with no rocks or other debris more than 1 inch diameter or common builder’s sand.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

B. Install warning tape six (6) inches above pressure piping, except 6 inches below subgrade under pavement and slabs.

C. Provide minimum cover over top of underground piping according to the following:

1. Irrigation Main Piping: Minimum depth of 18 inches
2. Circuit Piping: 12 inches
3. Drip line, and drip line supply and exhaust headers: 4 inches (including 2” of settled mulch)
4. Sleeves: 24 inches under roadways; 18” under walkways

3.2 PREPARATION

A. Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.

3.3 PIPING INSTALLATION

A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved by Architect.

B. Install piping free of sags and bends.

C. Install groups of pipes parallel to each other, spaced to permit servicing.

D. Install fittings for changes in direction and branch connections.

E. Lay piping on solid sub base, uniformly sloped without humps, depressions, sharp rocks, roots, etc.

F. Materials unsuitable for bedding of pipe to be removed to a depth 4" below trench bottom, and replaced with suitable bedding material as directed by the Owner’s Representative. Suitable bedding material shall be: excavated trench material, free from rocks, roots, sticks, debris or other sharp objects over one inch in diameter; or sand, as required.

G. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.

H. Install piping in sleeves under parking lots, roadways, and sidewalks.

I. Install sleeves made of Schedule 40 PVC pipe and socket fittings, and solvent-cemented joints.

J. Install dielectric fittings for dissimilar-metal pipe connections according to the following:

1. Underground Piping:

    a. NPS 2 and Smaller: Dielectric coupling or dielectric nipple.
    b. NPS 2-1/2 and Larger: Prohibited except in control-valve box.

K. Partial back-filling, leaving all joints exposed, is permissible prior to pressure tests.

3.4 JOINT CONSTRUCTION

A. Copper-Tubing Soldered Joints: Apply ASTM B 813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

B. PVC Piping Solvent-Cemented 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. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
3. PVC Nonpressure Piping: Join according to ASTM D 2855.
4. Install per pipe and cement manufacturers' recommendations
5. Allow main line to cure 12hrs before pressurizing

3.5 VALVE INSTALLATION

A. Automatic, gate, and quick-coupler valves: install per Plans and Details.

B. Perform two fully open flushings of mainline: one before control valve installation, and one after to flush control valves.

C. Coordinate with other trades for concrete valve box and sleeving installation in the poured concrete flooring of the keeper areas.

3.6 BACKFLOW DEVICE INSTALLATION

A. RP device: install per Plans and Details.

3.7 SPRINKLER INSTALLATION

A. Install sprinklers after hydrostatic test is completed.

B. Fully flush all lateral lines before final sprinkler and nozzle installation.

C. Install sprinklers at manufacturer's recommended heights.

D. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls and other boundaries, unless otherwise indicated.

E. Install per Plans and Details

3.8 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

A. Equipment Mounting: Install controller where shown on plans.

1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Coordinate with Owner's Representative for connection to 120V power source (if required).

B. Install control cable in same trench as irrigation piping, below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.9 CONNECTIONS

A. Connect to water line at the stub-out. Notify owners' representative 24hr before anticipated installation date.

B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.

C. Connect wiring between controllers and automatic control valves.

3.10 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment.

1. Install control valve ID tags with plastic zip-ties or bailing wire around the inlet side of the valve. Do not install in such a way that the tag will interfere with maintenance practices.

B. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Division 31 Section "Earth Moving" for warning tapes.

3.11 FIELD QUALITY CONTROL

A. Hydrostatic Pressure Tests

1. Make hydrostatic tests only in the presence of the Owner's Representative. No pipe shall be backfilled until it has been inspected, tested and approved. Contractor may partially backfill trenches, leaving all joints and fittings exposed.
2. Furnish necessary pump, gauges and all other test equipment.
3. All PVC main lines with gate (isolation), control, and quick-coupler valves installed and closed shall be flushed and pressure tested with all joints exposed to one hundred fifty (150) psi until watertight. Maximum psi loss in a sixty (60) minute test period shall be five (5) psi.

4. Close all gate valves after complete pressurization. Install additional pressure gauges where needed between areas isolated by gate valves.
5. Similarly, all PVC lateral lines with risers installed and capped shall be flushed and pressure tested with all joints exposed at service pressure for 30 minutes. Maximum psi loss allowed shall be five (5). The Owner's Representative shall visually inspect all lateral lines, joints, and swing joints for leakage.
6. To be valid, all tests must be witnessed and approved by the Owner's Representative. The contractor must give the Owner's Representative forty-eight (48) hours' notice prior to the anticipated date of inspection.
7. All gauges used in the testing of water pressures shall be either brand new-in-box, or certified correct by an independent testing laboratory immediately prior to use on the project. Present certification at time of testing. Gauges shall be re-tested when directed by the Owner's Representative.
8. All testing shall be approved prior to installation of irrigation heads.

B. Coverage Test

1. Before the irrigation system will be accepted, the Contractor, in the presence of the Owner's Representative, shall perform a water coverage test for each zone of the system. Contractor to be responsible to change nozzles, etc. at discretion of Owner's Representative in order to obtain full coverage with minimum over spray. Contractor will be required to adjust and/or replace nozzles, etc. to meet this requirement. Prior to arrival of Owner's Representative, the Contractor shall accomplish the following: complete all work including balancing, adjusting the system (pressure reducing valves, flow adjustment keys, nozzles, etc.) to provide optimum coverage without fogging.
2. Notify the Owner's Representative at least forty-eight (48) hours in advance of coverage test.

C. Complete System Test (Punch List)

1. Upon approved completion of the Coverage Test, trenching and installation of all equipment, the Contractor shall request a Complete System Inspection of the entire irrigation system including: backfilling, irrigation heads, valves, valve boxes, controller and all other equipment.
2. From this inspection, a punch list shall be prepared by the Owner's Representative and presented to the Contractor for completion. The Owner's Representative shall give a date for completion of the punch list, not to exceed two weeks.
3. Notify the Owner's Representative at least forty-eight (48) hours in advance of Complete System Inspection. The Contractor shall be responsible for having a two-way communication system or sufficient personnel so that directions from the inspection

3.12 STARTUP AND WINTERIZATION SERVICE

A. Provide one complete start-up and one winterization during the first year of operation of this system.

1. If system installation is completed in the fall or winter, the winterization at this time counts as the one to be provided. Start up service the following spring will complete the obligation.
2. If system installation is completed in the spring or summer, a winterization the following fall, plus the startup the following spring will complete the obligation.

3.13 SYSTEM OPERATION AND TRAINING SESSION

A. A training and orientation shall be required. The Contractor, the irrigation subcontractor and the Owner's Representative shall be present. The date and time of the session shall be subject to approval of the Owner's Representative.

B. The "As-Built" plants shall be reviewed and all features explained. The "As-Built" plans shall consist of red-lined corrections, notes, comments, etc. on a clean bond copy print. Any major deviations from the original design as previously approved shall be documented on the As-Builts and explained at the session. All critical dimensions shall be shown. The Consultant shall review and approve the "As-Built" plans submitted.

C. The complete maintenance and operations manuals prepared by the Contractor shall be turned over to the Owner's Representative at the final inspection.

D. The contractor shall turn over all the necessary keys and/or other tools necessary to operate/drain/activate the system and spend sufficient time with the Owner's Representative to insure that the system operation/maintenance/winterizing can continue after departure of the Contractor.

3.14 GUARANTEE

A. Contractor shall submit a written guarantee, in approved form, stating that all work showing defects in materials or workmanship will be repaired or replaced at no cost to the Owner for a period of one (1) year from date of Final Completion.

B. A final site meeting shall take place eleven months after the date of final Completion. The system shall be examined by the Owner to determine if the system requires alterations or replacements covered in the Guarantee.

C. The sample Guarantee Form following this section may be re-typed on Contractor's letterhead and contain the following information:

GUARANTEE FOR IRRIGATION SYSTEM

Project Name

We hereby guarantee that the irrigation system we have furnished and installed for the FWPS Support Services Center is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse, or neglect excepted.

We agree to repair or replace any defects in materials or workmanship, which may develop during the period of one year from date of Final Completion. We also agree to correct any damage resulting from the repairing or replacing of such defects at no additional cost to the Owner. We shall make such repairs or replacements within a reasonable time, as determined by the Owner, after receipt of written notice. In the event of our failure to make such repair or replacements within a reasonable time after receipt of written notice, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

Project Name: _____

Designer of Work: _____

Project Location: _____

Authorized Contractor Representative

Signed: _____Date_____

Title: _____

Approved by: _____

(Project Owner)

Effective Dates of Guarantee

Start (Approved Date of Final Completion): _____

Warranty Testing Date / Completion of Guarantee Period: _____

END OF SECTION 328400

SECTION 329115 – ANIMAL SUBSTRATES (PERFORMANCE SPECIFICATION)

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 Management Yard and Building substrates specified according to performance requirements of the mixes.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

B. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

C. Imported Soil: Soil that is transported to Project site for use.

D. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

E. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

F. 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.

G. 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.

H. 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.

I. 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.

J. Topsoil: ASTM D 5268, fertile, naturally sandy loam as defined by USDA Handbook no. 18, Figure 38. It shall be natural, surface soil in a friable condition and contain less than 3% subsoil. The topsoil shall be free of hardpan material, stones and clods larger than ½ inch in diameter, sticks, tree or shrub roots, debris, toxic substances (e.g. Residual herbicides) and other material detrimental to plant growth. The area and the topsoil shall be free of plant or plant parts of undesirable plants such as, but not limited to, Bermuda grass, nut sedge, mugwort, Johnson grass, Quack grass, Canada Thistle or noxious weeds as set forth in the Federal Seed Act. It shall be certified free of Southern Blight.

K. USCC: U.S. Composting Council.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Material Certificates: For each type of imported soil and soil amendment before delivery to the site, according to the following:

    a. Manufacturer's qualified testing agency's certified analysis of standard products.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

C. Field quality-control reports.

D. Notify the COTR of location of all sources of the topsoil and furnish a certified report from the agricultural experiment station or approved agricultural laboratory of an analysis performed not more than 60 days prior to the date of submission. If the topsoil is a mix, it shall be mixed off-site. The topsoil shall be certified to meet the following requirements:

a. Shall be a natural, original surface soil of a sandy loam texture with a mechanical analysis of 65-70% sand, 25-30% silt and 5-10% clay.

b. Shall have at least 2%, but not more than 5%, organic matter.

c. Soil pH shall be 5.5 to pH 6.5 inclusive unless otherwise specified.

d. Soil salinity by electrical conductivity measurement shall not exceed 600 parts per million (ppm) as determined by Black, Editor "Method of Soil Analysis," Part 2, published by the American Society of Agronomy, 1965.

e. The soil nutrient level shall be greater than 100 lbs./acre of magnesium, 150 lbs./acre of phosphorous and 120 lbs./acre of potassium.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service. Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil and imported soil.

1. Notify COTR-Smithsonian Institute seven days in advance of the dates and times when laboratory samples will be taken.

1.9 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

1. Number and Location of Samples: Three representative soil samples from varied locations for each soil to be used or amended for landscaping purposes.
2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to COTR-Smithsonian Institute for its records.
4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.10 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

   a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
   b. Hydrometer Method: Report percentages of sand, silt, and clay.

2. Bulk Density: Analysis according to core method of SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
4. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
5. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85 percent compaction according to ASTM D698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."

D. Fertility Testing: Soil fertility analysis according to standard laboratory protocol of SSA NAPT NCR-13, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.

13. Sodium ppm and sodium absorption ratio.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3-Chemical Methods."

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance 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 or plants.
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. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 MANAGEMENT YARD SUBSTRATE

A. Yard Substrate: A washed (for dust control purposes) manufactured 3/16” decomposed granite mix placed over compacted native subsoil to provide a well-drained and stable walking and resting surface for animals.

1. Sieve Size and Percent Passing

1/2"	100%
3/8”	90-100%
No.4	50-100%
No. 30	25-55%
No.100	10-20%
No.200	5-18%

2. Percentage of Organic Matter: Zero.
3. Soil Reaction: pH of 6.5 to 7.5.
4. Soluble-Salt Content: Zero.

B. Source: Aggtrans
7535 RaukRiad Avenue
Hanover, Maryland, 21076-3141
888-766-4242
www.aggtrans.com

2.2 INTERIOR SAND SUBSTRATE:

A. NZP to provide a sample of sand to the General Contractor to source and match for the indoor hornbill bird enclosure.

2.3 INTERIOR SOIL SUBSTRATE:

A. For use only in the outdoor Hornbill bird enclosure, use a blended mixture of 70% sand and 30% compost. The sand shall washed angular and sub-angular blended sand with high sphericity that, when mixed with organic soil amendments, will create a well-drained and stable walking surface.

B. Source: Aggtrans
7535 Railroad Avenue
Harmans, Maryland, 21077
410-766-4242
www.aggtrans.com

2.4 INORGANIC SOIL AMENDMENTS

A. Limestone: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
2. Form: Provide lime in form of ground dolomitic limestone.
3. Applied at not more than 5 pounds per cubic yard of top soil may be used to adjust an acidic condition provided it is well mixed in a manner, which does not destroy the structure of the soil.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.

C. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.

D. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C33/C33M.

2.5 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Feedstock: Limited to leaves and the COTR-Smithsonian Institute's composted materials. Cannot include any sewage sludge or non-zoo animal waste.
2. Reaction: pH of 6.5 to 7.5.
3. Soluble-Salt Concentration: Less than 4 dS/m.
4. Moisture Content: 35 to 55 percent by weight.
5. Organic-Matter Content: 50 to 60 percent of dry weight.
6. Particle Size: Minimum of 98 percent passing through a 1-inch sieve.
7. Partially Decomposed Wood Derivatives: In lieu of shredded and composted wood derivatives, mix shredded and partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.

B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.6 FERTILIZERS

C. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

D. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

E. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

F. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

Topsoil that has been synthesized by blending materials which individually do not meet the requirements of this specification will not be accepted even though the resulting blend meets the organic matter, mechanical analysis, pH and soluble salts requirements.

The COTR reserves the right to inspect and sample all topsoil at the source and at the time of delivery. These inspections will be made without cost to the Contractor.

Tooil must not be delivered or handled in a frozen or muddy condition.

Shipment and Delivery - All soil must be approved by the COTR before delivery to the site. Any material not meeting requirements of this specification will be rejected on or after delivery.

PART 3 - EXECUTION

3.1 GENERAL

A. Topsoil that has been synthesized by blending materials which individually do not meet the requirements of this specification will not be accepted even though the resulting blend meets the organic matter, mechanical analysis, pH and soluble salts requirements.

B. The COTR reserves the right to inspect and sample all topsoil at the source and at the time of delivery. These inspections will be made without cost to the Contractor.

C. Topsoil must not be delivered or handled in a frozen or muddy condition.

D. Shipment and Delivery - All soil must be approved by the COTR before delivery to the site. Any material not meeting requirements of this specification will be rejected on or after delivery.

E. Place planting soil and fertilizers according to requirements in other Specification Sections.

F. 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.

G. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

B. Unsuitable Materials: Clean soil to contain a combined maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

C. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.3 BLENDING PLANTING SOIL IN PLACE

A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of 12 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off COTR-Smithsonian Institute's property.

C. Mixing: Apply soil amendments, compost and fertilizers, as required, evenly on surface to a 9” depth, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.

1. If testing requires it, mix lime and sulfur with dry soil before mixing fertilizer.
2. Mix fertilizer with planting soil no more than seven days before planting.

D. Compaction: Compact blended planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

A. Application: Apply compost component of planting-soil mix 3 inches of compost to surface of in-place amended planting soil. Compact compost with a hand roller to minimize possible erosion. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a

reference test value based on laboratory testing according to ASTM D698. Space tests at no less than one for each 1000 sq. ft. of in-place soil or part thereof.

2. Performance Testing: For each amended planting-soil type, demonstrating compliance with specified performance requirements. Perform testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

C. Soil will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.6 PROTECTION

A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."

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. If planting soil or subgrade is over-compacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by COTR-Smithsonian Institute and replace contaminated planting soil with new planting soil.

3.7 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off COTR-Smithsonian Institute's property unless otherwise indicated.

1. Dispose of excess subsoil and unsuitable materials on-site where directed by COTR-Smithsonian Institute.

END OF SECTION 329115

SECTION 329200 – TURF AND GRASSES

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. Seeding.

B. Related Requirements:

1. Section 329115 “Soil Preparation” for planting substrates.

2. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. USE OF PESTICIDES AND HERBICIDES IS NOT ALLOWED ON THIS PROJECT.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation (Performance Specification)" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

Certification of each seed mixture for turfgrass sod and sprigs. Include identification of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: USE OF PESTICIDES AND HERBICIDES IS NOT ALLOWED ON THIS PROJECT.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by COTR-Smithsonian Institute for maintenance of seeded during one growing season. Submit before expiration of required maintenance periods.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

1.8 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting Substantial Completion.

1. Spring Planting: After last hard frost date (generally April 2nd)
2. Fall Planting: Before first hard frost date (generally November 10th)

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be

obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality, State Certified: State-certified seed of grass species as listed below for solar exposure.
2. Sun and Partial Shade, Cool-Season Grass: Zoo Mix as supplied by Newsome Seed, Inc., 11799 Scaggsville Road, Fulton, Maryland 20759. 1-800-553-2719. Proportioned by weight as follows:

    a. 16.42% Volt percent Kentucky bluegrass.
    b. 16.42% Cajun 2 Tall Fescue.
    c. 16.34% Potomac Orchardgrass.
    d. 16.34% Climax Timothy.
    e. 16.34% McKinley Annual Ryegrass.
    f. 16.34% Nutrigraze Perennial Ryegrass

2.2 PESTICIDES

A. General: USE OF PESTICIDES AND HERBICIDES IS NOT ALLOWED ON THIS PROJECT.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

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 a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by COTR-Smithsonian Institute and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 SEEDED AREA PREPARATION

A. General: Prepare areas to be seeded according to Section 329115 "Soil Preparation (Performance Specification)."

B. Moisten prepared area before seeding if soil is dry. Water thoroughly and allow surface to dry before seeding. Do not create muddy soil.

C. Before seeding, obtain COTR-Smithsonian Institute's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 HAND SEEDING

A. Sow seed with rotary spreader. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h).

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
2. Do not use wet seed or seed that is moldy or otherwise damaged.
3. Do not seed against existing trees. Limit extent of seed to outside edge of planting areas.

B. Sow seed at a total rate of 4 lb/1000 sq. ft.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

E. Overseed sodded turf areas at a rate of 2 lbs/1000 sq. ft.

3.5 TURF

A. Turf installations shall meet the following criteria as determined by COTR-Smithsonian Institute:

1. Satisfactory Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.6 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off COTR-Smithsonian Institute's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.7 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

END OF SECTION 329200

SECTION 329300 - PLANTS

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. Plants.
2. Tree stabilization.
3. Temporary tree watering bags

B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 329115 “Soil Preparation” for planting substrate.
3. Section 329200 "Turf and Grasses" for turf planting.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not

less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

G. Finish Grade: Elevation of finished surface of planting soil.

H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides. NOTE THAT USE OF PESTICIDES AND HERBICIDES IS NOT ALLOWED AS PART OF THIS PROJECT.

I. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

J. Planting Area: Areas to be planted.

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

M. Root Flare: Also called "trunk flare." The area at the base of the plant'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.

N. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

O. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Plant Photographs: Include color photographs in jpeg format with min 600 dpi resolution. of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:

1. Organic Compost Mulch: 1-quart (1-L) volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
2. Proprietary Root-Ball-Stabilization Device: One unit.
3. Slow-Release, Tree-Watering Device: One unit of each size required.

1.6 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by COTR-Smithsonian Institute for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the National Association of Landscape Professionals or AmericanHort.
2. Experience: Three years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the National Association of Landscape Professionals:

    a. Landscape Industry Certified Technician - Exterior.
    b. Landscape Industry Certified Horticultural Technician.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: COTR-Smithsonian Institute may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. COTR-Smithsonian Institute may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent

defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify COTR-Smithsonian Institute of sources of planting materials seven days in advance of delivery to site.

1.9 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 compliance 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 or plants.
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. Deliver bare-root stock plants within 36 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

G. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.

2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.10 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: After last hard frost date (generally April 2nd)
2. Fall Planting: Before first hard frost date (generally November 10th)

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by COTR-Smithsonian Institute.
   b. Structural failures including plantings falling or blowing over.
   c. Faulty performance of tree stabilization.

2. Warranty Periods: From date of substantial completion.

   a. Trees, Shrubs, Vines, and Ornamental Grasses: one full year.
   b. Ground Covers, Biennials, Perennials, and Other Plants: one full year.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.

2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to COTR-Smithsonian Institute, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

2.2 FERTILIZERS

A. Liquid fertilizers: Miracle-Gro or similar liquid fertilizer that is surface-applied via watering. No granular or tablet fertilizers are allowed.

1. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

A. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inch sieve; soluble-salt content of 2 to 5 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.

2.4 PESTICIDES AND HERBICIDES

A. NOTE THAT USE OF PESTICIDES AND HERBICIDES IS NOT ALLOWED AS PART OF THIS PROJECT.

2.5 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood or softwood with no wood pressure-preservative treatment, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
2. Guys and Tie Wires: ASTM A641/A641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch in diameter.

3. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.

2.6 TREE-WATERING DEVICES

A. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over an extended time period prior to the implementation of a viable irrigation system**;** manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.

1. Treegator watering bags: https://www.forestry-suppliers.com/product_pages/products.php?mi=66481&itemnum=79128
2. Color: green.

2.7 MISCELLANEOUS PRODUCTS

A. Wood Pressure-Preservative Treatment: No wood pressure-preservative treated wood is allowed within the animal habitat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

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 a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by COTR-Smithsonian Institute and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain COTR-

Smithsonian Institute's acceptance of layout before excavating or planting. Make minor adjustments as required.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation (Performance Specification)."

B. Placing Planting Soil: Blend planting soil in place.

C. Before planting, obtain COTR-Smithsonian Institute's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter for all plant stock.
3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
6. Maintain supervision of excavations during working hours.
7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.

B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify COTR-Smithsonian Institute if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

D. Drainage: Notify COTR-Smithsonian Institute if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE AND SHRUB PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, 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.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch (25 mm**)** above adjacent finish grades.

1. Backfill: use excavated soil for backfill.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

D. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch (25 mm**)** above adjacent finish grades.

1. Backfill: use excavated soil for backfill.
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

E. Fabric Bag-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch (25 mm) adjacent finish grades.

1. Backfill: use excavated soil for backfill.
2. Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.

3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

F. Bare-Root Stock: Set and support each plant in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grade.

1. Backfill: use excavated soil for backfill.
2. Spread roots without tangling or turning toward surface. Plumb before backfilling, and maintain plumb while working.
3. Carefully work backfill in layers around roots by hand. Bring roots into close contact with the soil.
4. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

G. Tree Watering Devices: After planting, apply Treegator watering bag around trunk and fill with water.

H. Slopes: When planting on slopes, set the plant 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.

3.6 TREE AND SHRUB PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by COTR-Smithsonian Institute, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

C. Do not apply pruning paint to wounds.

3.7 GROUND COVER AND PERENNIAL PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings naturalistically, to avoid even rows.

B. Use excavated planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.8 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Organic Mulch in Planting Areas: Apply 3-inch (75-mm) over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.9 INSTALLATION OF SLOW-RELEASE WATERING DEVICE

A. Provide one Treegator device for each tree.

B. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.10 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices, when possible, to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.11 PESTICIDE APPLICATION

NOTE THAT USE OF PESTICIDES IS NOT ALLOWED AS PART OF THIS PROJECT.

3.12 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by COTR-Smithsonian Institute.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by COTR-Smithsonian Institute.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that COTR-Smithsonian Institute determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree of 4 inches (100 mm) or smaller in caliper size.
2. Species of Replacement Trees: Same species being replaced.

3.13 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off COTR-Smithsonian Institute's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.14 MAINTENANCE SERVICE

A. Maintenance Service for all Planting Materials: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: one full year from date of substantial completion.

END OF SECTION 329300

SECTION 33 4100 – 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. PVC pipe and fittings
2. Storm Sewer pipe and fittings
3. Cleanouts
4. Drains
5. Manholes
6. Concrete
7. Public stormwater inlets
8. Stormwater detention structures
9. Stormwater Quality
10. Earthwork
11. General
12. Pipe installation
13. Pipe and joint construction
14. Cleanout installation
15. Drain installation
16. Manhole and catch basin installation
17. Private storm sewer connections
18. Stormwater inlet and outlet installation
19. Concrete placement
20. Stormwater disposal system installation
21. Connections
22. Closing abandoned storm drainage systems
23. Pipe lining by thermoformed pipe method
24. Identification
25. Field quality control
26. Minimum requirements for as-built plan

27. Cleaning

1.3 APPLICABLE SPECIFICATIONS

A. American Society for Testing and Materials (ASTM)

B. DC Department of Transportation, Standards and Guidelines

1.4 APPLICABLE REFERENCE

A. DC's Standards and Specifications Manual

B. Erosion and Sediment Control Field Handbook

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Submit full descriptions and details of all pipe and appurtenances proposed for the project.

C. Submit certifications from the manufacturers that the inspections and test specified in the referenced standards have been made and that the results of such inspections and tests comply with the requirements of the applicable standard. Certificates of compliance and approval shall apply.

D. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins, stormwater inlets, and dry wells. Include plans, elevations, sections, details, frames, covers, and grates.
3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1-inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet.

Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

C. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.

D. Field quality-control reports.

E. Submit full descriptions and details of all pipe and appurtenances proposed for the project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, 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.

D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.8 PROJECT CONDITIONS

A. Quality Assurance

1. The manufacturer shall provide facilities or a certified laboratory for conducting load bearing, hydrostatic and other tests required for production by the ASTM.
2. The Engineer will inspect pipe, fittings, and joint material upon delivery to the site. The Contractor shall provide ample space between rows of stockpiled pipe to facilitate the inspection.
3. Final inspection will be conducted by the Engineer upon completion of final paving and finished grading.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Water-Service Piping:

1. Pipe: ASTM D 1785, Schedule 40 and Schedule 80 PVC, with plain ends for solvent-cemented joints.

2. Fittings: ASTM D 2466, Schedule 42a20 and ASTM D 2467, Schedule 80 PVC, socket type.

2.2 STORM SEWER PIPE AND FITTINGS

A. Concrete Storm Sewer Pipe

As indicated in the plan storm sewer pipes may be reinforced concrete pipe with a minimum inside diameter of 15-inches. Reinforced concrete pipe shall be Class III, IV, or V as called for on the plans and shall conform to the specifications of ASTM C-76. The pipe shall have bell and spigot ends with "O-ring" gasket joints conforming to ASTM C-443. Alternate materials may be approved by the District on a case by case basis.

B. High-Density polyethylene (HDPE) Storm Sewer Pipe

As indicated in the plan storm sewer pipes may be HDPE pipe. This specification describes 4- through 60-inch (100 to 1500 mm) ADS N-12 WT IB pipe (per AASHTO) for use in gravity-flow land drainage applications. Equal materials and/or manufacturers may be utilized if approved by Engineer of Record.

1. Pipe: ADS N-12 WT IB pipe (per AASHTO) shall have a smooth interior and annular exterior corrugations.
   a. 4- through 10-inch (100 to 250 mm) pipe shall meet AASHTO M252, Type S.
   b. 12- through 60-inch (300 to 1500 mm) pipe shall meet AASHTO M294, Type S or ASTM F2306.
   c. Manning's "n" value for use in design shall be 0.012.

2. Joint Performance: Pipe shall be joined using a bell & spigot joint meeting the requirements of AASHTO M252, AASHTO M294, or ASTM F2306. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly. 12- through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.

3. Fittings: Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle

gasket meeting the watertight joint performance requirements of AASHTO M252, AASHTO M294, or ASTM F2306.

4. Field Pipe and Joint Performance: To assure watertightness, field performance verification shall be accomplished by testing in accordance with ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material. Contact the manufacturer for recommended leakage rates.

5. Material Properties: Material for pipe and fitting production shall be high-density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch (100 to 250 mm) diameters, and 435400C for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The 12- through 60-inch (300 to 1500 mm) pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306 respectively.

6. Installation: Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot. (0.3 m) and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted), Class 2 (minimum 90% SPD) or Class 3 (minimum 95%) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.01. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

C. Storm Sewer Pipe Under Building Slab

All storm sewer pipes under building slab must be reinforced concrete pipe with a minimum inside diameter of 15-inches. Reinforced concrete pipe shall be Class III, IV, or V as called for on the plans and shall conform to the specifications of ASTM C-76. The pipe shall have bell and spigot ends with “O-ring” gasket joints conforming to ASTM C-443. Alternate materials may be approved by the District on a case by case basis. Additionally, a form-and-form liner shall be installed to continuously seal the interior of the pipe run. Fold-and form liner must comply with ASTM F1871 and ASTM F1504.

2.3 CLEANOUTS

A. Cast-Iron Cleanouts:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Josam Company
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.
    d. Tyler Pipe
    e. Watts Water Technologies, Inc.
    f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group

3. Description: 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.
4. Top-Loading Classification(s): Light Duty, Medium Duty, Heavy Duty, and, Extra-Heavy Duty.
5. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. Plastic Cleanouts:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    a. Canplas LLC.
    b. IPS Corporation.
    c. NDS Inc.
    d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
    e. Sioux Chief Manufacturing Company, Inc.
    f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.
3. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.4 DRAINS

A. Cast-Iron Area Drains:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Nyloplast
    b. Josam Company
    c. MIFAB, Inc.
    d. Smith, Jay R. Mfg. Co.
    e. Tyler Pipe
    f. Watts Water Technologies, Inc.
    g. Zurn Specification Drainage Operation; Zurn Plumbing Products Group

3. Description: ASME A112.6.3 gray-iron round body with anchor flange and round secured grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.
4. Top-Loading Classification(s): Medium and Heavy Duty.

B. Cast-Iron Trench Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Josam Company
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.
    d. Tyler Pipe
    e. Watts Water Technologies, Inc.
    f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group

3. Description: ASME A112.6.3, 6-inch- wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular [secured] grate. Include units of total length indicated and quantity of bottom outlets with inside calk or spigot connections, of sizes indicated.
4. Top-Loading Classification(s): Heavy Duty

2.5 MANHOLES

A. Standard Precast Concrete Manholes:

1. Precast concrete manhole bases, risers and cones shall conform to the requirements of ASTM C-478 with configurations as shown in the drawings. Cones shall be eccentric.

2. Each precast section shall be clearly marked on the inside near the top with the following information where applicable: ASTM designation, Standard detail or drawing number, station location and designation, date of manufacture and name or trademark of manufacturer. Precast concrete manholes shall be manufactured by Americast, or approved equal.

B. Manhole Frames and Covers:

1. Manhole frames and covers shall be constructed of gray or ductile iron conforming to ASTM A-48 and A-536. Frames and covers shall have machined bearing surfaces to prevent rocking and rattling under traffic. Manhole covers shall be as shown on the Construction Standards and as indicated on the Contract Drawings. Frames and covers shall be manufactured by Dewey Brothers Inc., or equal.

C. Mortar:

1. Mortar used in manhole construction shall be one part of Portland cement conforming to ASTM C-150, Type II, and two parts of sand conforming to ASTM C-144, with enough water added to produce mortar of the proper consistency for the type of joint.

D. Manhole Neck Adjustments:

1. Adjustments to manhole necks shall be limited to 2 inches of concrete. Concrete adjustment rings shall be used for adjustments in excess of 2 inches, but not to exceed 12 inches. Nonshrink grout shall be used between adjustment rings.

E. Manhole Steps
1. Manhole steps shall be a composite of No. 3 grade 60 deformed steel bar incased in copolymer polypropylene plastic of the “press-fit” design or rubber. Steps shall be PSI-PF as manufactured by M.A. Industries, Inc. or Wedge-Lok as manufactured by Delta Pipe Products Inc., or approved equal.

2.6 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

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: 1 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

   a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

2.7 PUBLIC STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to DDOT Standards and Guidelines.

B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions according to DDOT Standards and Guidelines. Include heavy-duty frames and grates.

C. Combination Inlets: Made with vertical curb and horizontal gutter openings of materials and dimensions according to DDOT Standards and Guidelines. Include heavy-duty frames and grates.

D. Frames and Grates: Heavy duty according to DDOT Standards and Guidelines

2.8 STORMWATER DETENTION STRUCTURES

A. Cast-in-Place Concrete, Stormwater Detention Structures: Constructed of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Ballast: Increase thickness of concrete as required to prevent flotation.
2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and cover.
3. Steps: Individual FRP steps or FRP ladder wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of structure to finished grade is less than 60 inches.

B. High-Density Polyethylene (HDPE), Stormwater Detention Structures: This specification describes ADS Retention/Detention Pipe Systems for use in non-pressure gravity-flow storm water collection systems utilizing a continuous outfall structure. Other equal products or manufacturers may be used as approved by Engineer of Record.
1. Pipe Requirements: ADS Retention/Detention systems may utilize any of the various pipe products below: •
   a. N-12 WT IB pipe (per AASHTO) shall meet AASHTO M294, Type S or ASTM F2306
   b. N-12 WT IB pipe (per ASTM F2648) shall meet ASTM F2648
   c. N-12 MEGA GREENTM WT IB shall meet ASTM F2648
2. Joint Performance: Watertight (WT IB): WT IB pipe shall be joined using a bell & spigot joint. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. 12- through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer. Pipe & fitting connections shall be with a bell and spigot connection utilizing a spun-on or welded bell and valley or saddle gasket. The joint shall meet the watertight requirements of ASTM D3212 and gaskets shall meet the requirements of ASTM F477. Detention systems are subject to greater leakage than typical single run storm sewer application and therefore are not appropriate for applications requiring long-term fluid containment or hydrostatic pressure. For additional details refer to ADS Technical Note 7.01 Rainwater Harvesting with HDPE Cisterns.
3. Fittings: Fittings shall conform to ASTM F2306 and meet joint performance requirements indicated above for fitting connections. Custom fittings are available and may require special installation criterion.

4. Installation: Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in non-traffic areas for 12- through 60-inch (300 to 1500mm) diameters shall be one foot (0.3m). Minimum cover in trafficked areas for 12- through 36-inch (300 to 900mm) diameters shall be one-foot (0.3m) and for 42- through 60-inch (1050 to 1500mm) diameters, the minimum cover shall be two feet (0.6m). Backfill shall consist of Class 1 (compacted) or Class 2 (minimum 90% SPD) material, with the exception that 60-inch fittings shall use Class 1 (compacted) material only. Minimum cover heights do not account for pipe buoyancy. Refer to ADS Technical Note 5.05 HDPE Pipe Flotation for buoyancy design considerations. Maximum cover over system using standard backfill is 8 feet (2.4m); contact a representative when maximum fill height may be exceeded. Additional installation requirements are provided in the ADS Drainage Handbook Section 6 Retention/Detention.

C. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- 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 "STORM SEWER."

PART 3 – EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 GENERAL

A. Maintain a minimum 5-feet horizontal distance between storm sewer and all other utilities.

B. Temporarily support, protect and maintain all underground and surface structures and utilities encountered in the process of the work. Where the grade or alignment of the pipe is obstructed by existing utilities, such as conduits, pipes or drains, the obstruction shall be permanently relocated by the Contractor in cooperation with the Owners of said utilities.

C. Use the proper tools for the safe handling and laying of pipe. Unload pipe by hand, skidways or hoists in such a manner so that material is not dropped or damaged. Distribute pipe at site of installation near area where it is to be laid. Protect machined ends of pipe from damage and keep pipe free from dirt and debris.

D. Install piping in such a manner as to obtain sufficient flexibility and to prevent excessive stresses in materials and excessive bending moments at joints. Conduct work in strict conformance with the procedures established by the manufacturers of the various types of pipe.

E. Bring any conflicts during the installation of piping to the attention of the Engineer.

F. All storm drainage facilities to be accepted by the District for perpetual maintenance shall be located such that maintenance and replacement can be accomplished without disturbing private-owned, permanent structures.

G. The minimum vertical clearance between storm sewer and other utilities shall be 1.0 foot, unless provisions to prevent damage to the underlying utility are detailed for approval by DPW.

H. Storm sewers shall be installed within public rights-of-way whenever possible. Proposed storm sewers shall be installed such that the following horizontal clearance from any private property lines or buildings are maintained. When a storm sewer cannot be installed with the minimum necessary horizontal clearance from private property, a permanent easement across the private property necessary to provide the horizontal clearances listed below shall be recorded prior to construction.
   1. 10 feet from center line of storm sewer mains less than 27 inches in diameter and 10 feet or less in depth.
   2. 15 feet from center line of storm sewer mains less than 27 inches in diameter and greater than 10 feet in depth.
   3. 15 feet plus half the diameter from the centerline of storm sewer mains greater than 27 inches, any depth.
   4. The above standards and specifications may be modified in instances where proposed development, site restrictions, and other unusual circumstances present unusual hardships and provisions are made to provide permanent sheeting shoring protection for the pipe.

I. Proposed easements shall be shown on plats prepared in conformance with plat standards prescribed in chapter 23, subdivisions, of the District's Code, and shall be submitted to the District for review and approval by the District Manager or designee. Deeds of easement shall be submitted to the District for review and approval, subject to the approval of the District Manager or designee, and approval as to form by the District Attorney.

J. No permanent structures, temporary structures, facilities or objects shall be placed within a storm sewer easement without the approval of the District.

K. No new permanent structure may be constructed adjacent to an existing storm drainage facility where that new permanent structure interferes with or encumbers the maintenance or rehabilitation of the existing storm drainage facility.

L. Design plans shall show and clearly label the location of all existing and proposed storm drainage easements.

M. Where required, design plans shall show cross sections to demonstrate that proposed facilities adjacent to District-owned storm drainage facilities will not impact the maintenance and reconstruction of the facility.

N. All plans and specifications for construction of proposed storm sewer facilities must be approved by the District. No sanitary sewer facilities shall be constructed without approved plans, shop drawings and construction cut sheets.

O. Pipes are to be stenciled at least once every four feet with permanent waterproof paint or approved equal. Stencil shall be minimum 1” letters STM for separated storm and CS for contaminated storm.

3.3 PIPING INSTALLATION

A. Lay pipe to a true uniform line and grade from elevations indicated on the drawings with continuous bearing of barrel on cradle or bedding material.

B. Lay pipe up-grade with the bell end pointing in the upstream direction and the spigot end pointing in the downstream direction. Lay each section of pipe in such a manner as to form a close concentric joint with the adjoining section and to prevent any sudden offsets in the flow line.

C. Ensure that pipe is well bedded on a solid foundation. Correct any defects due to settlement. Excavate bell holes sufficiently large to ensure making of proper joints. Exercise precautions to include the furnishing and placing of bedding to prevent any pipe from resting directly on rock.

D. Plug or grout lift holes left in the pipe prior to backfilling operations.

E. As the work progresses, clear the interior of the pipe of all dirt and superfluous materials of every description.

F. Keep trenches and excavations free of water during construction and until final inspection. Do not lay pipe in water or in a frozen bedding condition. Prevent flotation and re-lay pipe that has floated.

3.4 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join hub-and-spigot, cast-iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
4. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
5. Join ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
6. Join corrugated steel sewer piping according to ASTM A 798/A 798M.
7. Join corrugated aluminum sewer piping according to ASTM B 788/B 788M.
8. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
9. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.6 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

1. Use Light-Duty, top-loading classification drains in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification drains in paved foot-traffic areas.
3. Use Heavy-Duty, top-loading classification drains in vehicle-traffic service areas.
4. Use Extra-Heavy-Duty, top-loading classification drains in roads.

B. Embed drains in 4-inch minimum concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

E. Assemble trench sections with flanged joints.

Embed trench sections in 4-inch minimum concrete around bottom and sides.

3.7 MANHOLE AND CATCH BASIN INSTALLATION

A. Construct manholes of precast concrete in accordance with Standard Details and the plans, unless directed otherwise. Provide monolithic base of precast construction and make water-tight connections between base and risers, unless modifications to the existing system are being performed. Manhole wall and bottom construction shall be such as to ensure water tightness. If directed by the District, the entire wall exterior shall be painted with waterproof coating. Place axis of manholes directly over the center lines of the pipes unless otherwise shown. The manhole foundation shall be adequately designed to support the manhole and any superimposed loads that may occur. Manholes in fill areas shall have a foundation extending a minimum depth of 18 inches into undisturbed earth and shall be designed only with prior approval from the District.

B. Construct appropriate flow channels in the bottom of manholes and catch basins as shown on the Construction Standards and plans. Cast-in-place concrete shall be a minimum four-inches thick, non-reinforced, 3000 psi concrete with smooth form troweled finish. Flow channel construction shall provide a smooth transition between adjacent sections. Provide a positive means of bonding channel to base of structure.

C. Cast-in-place concrete for manholes and catch basins shall be placed monolithically. Concrete shall be allowed to drop freely up to five-feet in height; where greater drops are required, a tremie or other device approved by the Engineer shall be used.

D. Joints for brickwork and precast concrete block work shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole. Brick shall be laid

radially with every sixth course laid as a stretcher courses. Brick and concrete block manholes and catch basins shall be parged over the entire inside surface of the walls.

E. Cut all pipes flush with the inside wall of the manhole structure. In 48-inch diameter precast structures, provide flexible rubber gasket between the structure wall and the incoming pipe. Provide field sleeve where required to assure a tight fit. In structures larger than 48-inches, secure pipe tightly into the wall with quick-setting non-shrink grout.

F. Firmly anchor manhole steps to wall according to manufacturer's recommendations. Steps shall be installed in accordance with Standard Drawing M-2.0.

G. Install vented or bolted manhole frames and covers, as indicated on the plans. Adjust the frame and cover to finished grade by brick or concrete adjusting ring construction.

H. For repair of existing structures, joints for brickwork and precast concrete block work shall be completely filled and shall be smooth and free from surplus mortar on the inside of the structure. Brick shall be laid radially with every sixth course laid as a stretcher course. Brick and concrete block manholes shall be plastered with mortar over the entire outside surface of the walls.

3.8 PRIVATE STORM SEWER CONNECTIONS

A. Storm Sewer Connections are privately owned and maintained from the storm sewer main up to and including the property served. Pipe and fitting for storm sewer service connections shall conform to the requirements of the DC Plumbing Code

B. No mechanical discharge of groundwater, stormwater, or other collected water onto the public right of way shall be permitted.

C. Connections to existing storm sewer mains shall be at manholes or inlets. The connection shall be made by core-drilling the structure and using a manhole adaptor appropriate for the pipe and structure materials. Connections at brick or masonry structures shall be made by carefully chiseling or removing single bricks or blocks such that the clearance between the connection pipe and any portion of the manhole is minimized.

D. Connections directly to pipes shall not be allowed without specific approval by the District Engineering Bureau and issuance of appropriate permits. Where specifically permitted by District, connections to existing pipes shall be made using saddles or fittings designed specifically for use on the pipe material which it is proposed to be used upon. Concrete saddles shall not be permitted.

For connections to pipes 24” and smaller, the saddle shall be a strap-style saddle with straps extending around the entire circumference of the pipe. Connections to pipes larger than 24” shall use saddles or fittings specifically designed and manufactured for such connection, with appropriate anchors. When anchors are set into concrete pipes, expansion anchors shall not be permitted. Such fittings or saddles shall eliminate any encroachment of the pump discharge pipe into the flow line of the existing pipe when flowing full. Saddles shall provide flexural relief for the pump discharge line without transmitting any stress onto the storm sewer pipe.

3.9 STORMWATER INLET AND OUTLET 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.

E. Construct energy dissipaters at outlets, as indicated.

3.10 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.11 STORMWATER DISPOSAL SYSTEM INSTALLATION

A. Chamber Systems: Excavate trenches of width and depth, and install system and backfill according to chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.

B. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill, according to piping manufacturer's written instructions.

3.12 CONNECTIONS

A. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

    a. Shielded flexible couplings for same or minor difference OD pipes.
    b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

3.13 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. When abandoning existing storm sewers; excavate and remove existing structure and storm sewer lines or abandon in place by filling pipes with flowable fill and plugging at all open ends. Excavate and remove structure to a minimum of 2 feet below finished grade, fill the structure with sand or DDOT aggregate material.

3.14 PIPE LINING BY THERMOFORMED (FOLD AND FORM) PIPE METHOD

A. GENERAL

1. DESCRIPTION OF WORK

a. The work specified under this section provides for the rehabilitation of an existing sewer pipeline or conduit using PVC Fold and Form trenchless technology. The process consists of installing a thermoformed PVC pipe liner inside an existing sewer (Host Pipe) from manhole to manhole as described in the following sections. When installed the liner will be a seamless, joint-less, solid wall PVC pipe liner that tightly conformed to the interior contours of the original host pipe. The liner shall be continuous from manhole to manhole with no seams or joints. In most cases required service connections will be reconnected using closed circuit television and remotely controlled cutters.

b. The Pipe liner shall be Premier Pipe (resin-impregnated cured in-place liner) manufactured by American Pipeliners or “Approved equal” and installed by a certified professional such as AM-Liner East.

2. REFERENCED DOCUMENTS

This specification references ASTM standards and other related standards, which are made a part hereof by reference and shall be the latest edition thereof.

ASTM D638 Standard Test Method for Tensile Properties of Plastics
ASTM D790 Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

ASTM D1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

ASTM F1947 Standard Practice for Installation of Folded/Formed Poly (Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer and Conduit Rehabilitation

ASTM F1504 Standard Specification for Folded/Formed Poly (Vinyl Chloride) Pipe Type A for Existing Sewer and Conduit Rehabilitation

ASTM F2122 Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

NASSCO SG-11.010/03 Specification for Sewer Line Cleaning

3. PAYMENT

Payment for the work included in this section will be in accordance with the unit prices set forth in the Bid for the quantity of work performed. Work incidental to the lining process such as, by-pass pumping, traffic control and other activities not listed on the Bid Form shall not be paid for directly but shall be considered subsidiary to the items on the Bid.

4. SCHEDULE 1 - SUBMITTALS

a. The contractor shall submit for approval:
   1) Shop Drawings, Product Data, Samples and Miscellaneous Submittals
   2) Product technical data including physical properties data sheet and manufacturers installation instructions.

b. Certifications:
   1) The Contractor shall be licensed directly by the manufacturer of the product and provide written certification that he is an experienced and qualified installer of the product.
   2) Manufacturers certification that the product meets the requirements of the standards referenced
   3) Submit documentation from the manufacturer that there is an established and ongoing quality control and quality assurance program for the product at the manufacturer's production facility. This should include proof that the manufacturer has the necessary equipment and trained personnel to properly implement the program.

c. Phasing Plan including:
   1) By-pass pumping procedure (if necessary)
   2) Order of construction

5. SAFETY

The Contractor shall conform to all work safety requirements of pertinent regulatory agencies, and shall secure the site for the working conditions in

compliance with the same. The Contractor shall erect such signs and other devices as are necessary for the safety of the work site.
The Contractor shall also perform all of the work in accordance with applicable OSHA standards. Emphasis shall be placed upon the requirements for entering confined spaces and working with steam.

6. AS-BUILT DRAWINGS

As Built drawings shall be provided by the Contractor within 2 weeks of final acceptance of the work. As-Built drawings will consist of marking the existing Contract Drawing with red pencil the changes between the existing Contract Drawings and Actual conditions measured or found in the field and the identification of work completed by the Contractor. The existing Contract Drawings will be provided to the Contractor at the onset of the project. As-Built drawings shall be kept on the project site at all times and shall be updated as the work is being completed. All updates to the contract documents shall be clearly legible.

B. PRODUCTS

1. BASIC MATERIALS
The pipe shall be made from PVC compound meeting all the requirements for cell classification 12334 as defined in specification D1784 and with minimum physical properties:

Tensile Strength	Test Method D638	6,000psi (41.4MPa)
Tensile Modulus (2206MPa)	Test Method D638	320,000psi
Flexural Strength	Test Method D790	6,000psi (41.4MPa)
Flexural Modulus (2206MPa)	Test Method D790	320,000psi
Heat Deflection Temperature	Test Method D648	115°F (46°C)
Tested @ 264psi (2MPa)		

2. OTHER REQUIREMENTS

a. Pipe Flattening
There shall be no evidence of splitting, cracking or breaking when the rounded pipe is tested according to section 11.3 of ASTM F1504.

b. Pipe Impact Strength

The impact strength of rounded pipe shall not be less than the values in Table 1 when tested in accordance with test method D2444 as referenced in ASTM F1504.

Table 1: Minimum Impact Strength at 73°F (23°C)

Pipe size, in. (mm)	Impact strength, ft-lb f (J)
6 (150)	210 (284)
8 (200)	210 (284)
10 (250)	220 (299)
12 (300)	220 (299)
15 (375)	220 (299)
18 (450)	220 (299)
24 (600)	220 (299)
30 (750)	220 (299)

c. Pipe Stiffness

Values for pipe stiffness for the rounded pipe shall comply with Table 2 when tested in accordance with test method D2412 as referenced in ASTM F1504.

Table 2: Minimum Pipe Stiffness at 5% Deflection

Pipe Size, in. (mm)	Pipe Stiffness, psi (kPa)	Dimension Ratio, (DR)
6 (150)	36 (250)	35
8 (200)	36 (250)	35
10 (250)	36 (250)	35
12 (300)	22 (153)	41
15 (375)	12 (83)	50
18 (450)	6 (41)	66
24 (600)	6 (41)	66
30 (750)	6 (41)	66

d. Extrusion Quality

The extrusion quality of the pipe shall be evaluated by both of the following test methods:

1) Acetone Immersion**:** The pipe shall not flake or disintegrate when tested in accordance with test method D2152 as referenced in ASTM F1504.
2) Heat Reversion**:** The extrusion quality of the pipe shall be estimated by heat reversion method in accordance with practice F1057 as referenced in ASTM F1504.
3) Flexural Properties: The flexural strength and modulus of the pipe shall be tested in accordance with test method D790 as referenced in ASTM F1504.

e. Dimensions

1) Formed Pipe Diameter: The average outside diameter of the formed pipe shall meet requirements in Table 3, +/- 1.0% when tested in accordance with test method D2122 as referenced in ASTM F1504.

2) Formed Pipe Wall Thickness: The wall thickness of the formed pipe shall not be less than the values specified in Table 3 when tested in accordance with test method D2122 as referenced in ASTM F1504.

Table 3: Formed Pipe Dimensions

Nominal Outside Diameter, in. (mm)	DR	Minimum Wall Thickness, in. (mm)
6 (150)	35	0.17 (4.34)
8 (200)	35	0.23 (5.78)
10 (250)	35	0.28 (7.23)
12 (300)	41	0.292 (7.4)
15 (375)	50	0.30 (7.6)
18 (450)	66	0.27 (6.8)
24 (600)	66	0.34 (8.7)
30 (750)	66	0.43 (10.8)

f. Workmanship, finish, and appearance
The formed pipe shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other defects. The pipe shall be as uniform as commercially possible in colour, opacity, density and other physical properties.

g. Product Marking
Pipe shall be clearly marked as follows at intervals of 5ft. (1.5m) or less:

• Manufacturer's name or trademark and code

• Nominal outside diameter

• The PVC cell classification, for example "12334"

• The legend "DR XX FOLDED PVC PIPE"

• The designation "Specification ASTM F1504"

• Length marker and liner distance label, for example "100ft" ("30.5m")

h. Packaging
The full length of the PVC pipe is coiled onto a reel in a continuous length for storage and shipment. The minimum diameter of the reel drum or core shall be 48in (1,219mm).

C. EXECUTION

1. PRE-INSTALLATION

a. Host Pipe Preparation
1) The host pipe shall be cleaned in accordance with SPECIFICATION FOR SEWER LINE CLEANING as provided by the National Association of Sewer Service Companies (NASSCO). For bidding purposes, the Contractor shall assume that the pipes require normal cleaning which is defined as two to three passes with a jet cleaner unless unique conditions are noted as special provisions, on the TV log sheets or videos made available to the Contractor before the bid opening. Special additional cleaning not identified will be paid for on a time and material basis.
2) Debris that would interfere with the installation of the pipe liner shall be removed. The Contractor shall dispose of debris in a location provided by the Owner and in accordance with all Federal, State and Local regulations
3) The pipeline shall be cleared of obstructions such as solids, dropped joints, protruding service connections or collapsed pipe that may

prevent pipe liner installation. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment then a point repair excavation shall be made to uncover and remove or repair the obstruction. Such point repair shall be approved in writing by the Owner's representative prior to commencement of the work and shall be considered as a separate pay item.

4) High levels of groundwater infiltration into the host pipe, that will affect the successful installation of the liner shall be remediated by either chemical grouting or point repair prior to lining as approved by the Engineer. Such repairs shall be approved in writing by the Owner's representative prior to commencement of the work and shall be considered as a separate pay item.

5) Pre-Lining television Inspection: Prior to lining the Contractor shall inspect the pipeline by means of closed-circuit television to identify any unknown defects or obstructions and to accurately locate active services. Color video recordings in DVD/CD, MPEG, or .avi format shall be made of the television inspections and two copies each shall be supplied to the Owner along with a computer generated or hand-written inspection report. The Contractor shall make accurate television inspection logs that clearly show the location, in relation to adjacent manholes, of each source of infiltration discovered. Other data of significance including the locations of service connections, joints, defective materials, unusual conditions, roots, storm sewer connections, collapsed sections, presence of scale and corrosion and other discernible features shall be recorded and two copies of such records shall be supplied to the Owner in printed format along with the video recordings. The contractor shall submit a report to the Owner detailing any defects in the pipeline that will prevent the successful installation of the liner. This report shall also contain a plan for proposed corrective action for repairs to the pipeline. Such repairs shall be approved in writing by the Owner's representative prior to commencement of the work and shall be considered as a separate pay item.

b. Flow Control

When required for acceptable completion of the pipe liner installation, the Contractor shall implement the pre-approved by-pass pumping plan in section 1.4.3.1.

2. LINER INSTALLATION

a. Pre-Heating

Prior to insertion of the liner into the host pipe the Contractor shall pre-heat the liner in the manner proscribed by the manufacturer's installation instructions. The heated liner must be pliable enough to be pulled into the host pipe with as little resistance as possible.

b. Pipe Liner Insertion

The liner pipe shall be inserted into the sewer through existing manholes, without modification of the manholes. Insertion of the liner into the host pipe will be accomplished by pulling the liner into the host pipe by means of a steel cable strung through the host pipe from a winch located at the downstream manhole. The end of the liner shall be prepared for attachment to the cable in accordance with the manufacturer's instructions. The connection between the pulling cable and the prepared end of the liner shall be a swivel device to prevent twisting of the liner as it is pulled through the host pipe. The heated liner coil shall be placed in such a manner as to prevent damage to the liner as it is pulled through the manhole and into the host pipe.

A member of the installation crew at the upstream end shall monitor the speed of the pull; he must coordinate the speed of the pull with the winch operator at the downstream manhole via two-way radio. The crewmember coordinating the insertion of the liner shall ensure that the liner has the proper amount of slack, to prevent it from being either stretched or kinked.

c. Stress Relief

After the liner has been inserted into the host pipe, the Contractor shall relieve any stress imparted to the liner during the insertion in a manner proscribed in the manufacturer's installation instructions.

d. Processing

The Contractor shall supply suitable heat source equipment. The equipment shall be capable of delivering steam through the lining section to uniformly raise the temperature of the PVC material to effect forming of the liner pipe.

Suitable monitors shall be installed to gauge steam temperatures and pressures at the input and exhaust ends of the liner. Steam monitoring methods and forming period shall be recommended by the liner manufacturer.

After forming the liner shall be cooled using compressed air or a mixture of compressed air and water. Cooling shall be deemed complete when the

temperature of the exhaust air or air water mixture has remained constantly below 90ºF for a minimum of 10 minutes.

e. Pipe Liner Trimming

After installation the ends of the PVC liner shall be cut off in the maintenance hole. The cuts shall be smooth and parallel with the maintenance hole wall. The finished liner shall not protrude into the maintenance hole over 4 inches.

If the maintenance hole has been lined through, the top half of the liner pipe may be cut off even with the top of the shelf, leaving the channel lined.

f. Sealing Manhole Connections

If a watertight seal is required at the manhole it may be accomplished by troweling a high viscosity epoxy cement or resin around the exposed ends of the liner and the surface of the manhole. The surface of the epoxy cement shall be shaped to smoothly transition the exposed liner to the manhole wall. If specified by the Owner a hydrophilic gasket may be placed between the pipe liner and the host pipe prior to expansion of the liner. In either case the exposed liner in the manhole shall be smoothly transitioned into the wall of the manhole using the epoxy cement.

g. Service Connections

The exact number and location of service connections shall be determined from the CCTV inspection done in section 3.1.3.5 of this specification. It shall be the Contractor's responsibility to accurately locate all existing service connections whether in service or not. The Contractor shall reconnect all potentially active service connections to the pipe liner, including those from unoccupied, abandoned or vacant lots. Capped service connections shall not be reconnected unless otherwise directed by the Owner. The Contractor shall be responsible for restoring/correcting, without delay, all missed service lateral connections. All service connections that are reinstated after lining shall be shown on the "As Built Drawings" with the exact distance from the upstream manhole.

All existing service connections shall be reinstated either by remotely controlled robotic device or by excavation.

Only experienced operators shall make robotic service connection reinstatements. Should a dimple not form or cannot be clearly ascertained at a given service connection its position must be carefully re-verified using the inspection video from 3.1.3.5.

Service reconnections shall be smooth and circular in nature as observed by a pan and tilt TV camera. The hole shall be a maximum of 105% and a minimum of 90% of the service pipe diameter. The opening shall be smooth and conform to the inside shape and size of the original connection. Trial cuts should be repaired per the pipe liner manufacturer's recommendations not be at no cost to the Owner.

3. POST INSTALLATION INSPECTION

Upon completion, and before acceptance of the work, the Contractor will inspect the rehabilitated pipeline using a CCTV camera with a pan and tilt head. The inspection shall be recorded on either SSD or DVD. The Operator will stop the camera at each lateral reinstatement and using the pan and tilt feature record and catalog each of the service connection cuts. The Contractor shall submit the post-installation video in either VHS or DVD format to the Owner for acceptance of the work.

4. INSPECTION AND TESTING

a. Visual Inspection

The pipe liner shall be continuous and joint-less. The pipe liner shall be free of all visual and material defects except those resulting from pre-lined host pipe conditions identified in the pre-lining video.

b. Testing

If required, the Contractor shall provide liner field samples to the Owner prior to installation for testing. The Owner will pay all expenses for the testing of liner samples to verify that the field samples meet the minimum specified values listed in Section 2.1. The samples shall be tested per the recommendations of the pipe liner manufacturer. The Contractor shall pay for the cost of re-tests made necessary by the failure of a sample to meet the minimum specified values listed in Section 2.1. Field samples shall be collected in accordance with Section 7.3 of ASTM F1947.

Normally separate leakage testing of the liner is not required, since the liner is under constant pressure during the cool down period. However, if separate leakage testing of the liner is required by the Owner in the specifications it shall be conducted at the time of installation after cool down and before the laterals are cut, in accordance with Section 7 of F1947.

5. DEFECT REPAIR OR REPLACEMENT

Any defects, which in the judgment of the Owner and the pipe liner manufacturer that will affect the integrity or strength of the liner, shall be repaired or the pipe liner replaced at the Contractor's expense per the pipe liner manufacturers recommendations. All repairs or replacement of defective work shall be completed to the full satisfaction of the Owner.

6. WARRANTY

The Manufacturer shall warrant the product for a period of 10 years from the date of manufacture, against failure as a result of defects in materials or manufacturing, and that when properly installed the product will perform in accordance with the Manufacturer's specifications, literature and data sheets.

3.15 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.16 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 reports for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

    a. Exception: Piping with soil tight joints unless required by authorities having jurisdiction.
    b. Option: Test plastic piping according to ASTM F 1417.
    c. Option: Test concrete piping according to ASTM C 924.

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.

3.17 MINIMUM REQUIREMENTS FOR AS-BUILT PLAN

A. Upon completion of the construction and prior to release of bonds or final payments by the District the Contractor shall submit and obtain approval of as-built plans. One set of as-built plans shall be provided on mylar and one copy in electronic format and shall include:
1. Invert elevations
2. Manhole top elevations
3. Percent of grade between structures
4. Horizontal distance between structures and manholes
5. Pipe material
6. Location of connection to existing system
7. Type of structures installed
8. Label on plan and profile the point of private and public responsibility for maintenance

3.18 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION