

other products contaminated with asbestos. Labels and signs shall comply with 29 CFR 1910.1001, 1926.62 and 1926.1101.

- G. The surfactant wetting agent shall be a 50/50 mixture of polyoxyethylene ether and polyoxyethylene ester, or equivalent, mixed in a proportion of 1 fluid ounce to 5 gallons of water or as specified by manufacturer. (An equivalent surfactant shall be understood to mean a material with a surface tension of 29 dynes/cm as tested in its properly mixed concentration, using ASTM method D1331-56- "Surface and Interfacial Tension of Solutions of Surface Active Agents.") Where work area temperature may cause freezing of the amended water solution, the addition of ethylene glycol in amounts sufficient to prevent freezing is permitted.
- H. Towels shall be disposable type and minimum size of 24 inches by 36 inches per towel.
- I. Spray adhesive (if used) shall not be noxious or toxic to workers or subsequent users of the area. Spray adhesive shall not contain methylene chloride.
- J. Make-up air filters dimensions shall be in accordance with exist installations.
- K. Insulation repair materials shall be a fiberglass cloth impregnated with an approved encapsulant that when dry forms a solid coating over the fiberglass cloth (wet wrap). Finish all repaired materials surfaces with latex paint or other Manufacturer recommended material after the wet wrap has completely dried.

2.02 GENERAL EQUIPMENT TO BE PROVIDED BY CONTRACTOR

- A. Exhaust Ventilation Unit shall be in accordance with ANSI Z9.2. and equipped with (HEPA) filters. This equipment shall be sufficient to maintain a minimum pressure differential of 0.02 inch of water column relative to adjacent, non-abatement areas. Filters on vacuum and exhaust equipment shall conform to ANSI Z9.2.

The Exhaust Ventilation Unit shall be equipped with the following:

1. A magnehelic gauge to monitor the unit's air pressure difference across the filters.
 2. An audible alarm with or without flashing red light for unit shutdown.
 3. A yellow warning light to indicate a decrease in air flow due to filter loading.
- B. Negative pressure automatic recording instrument(s), one per active work area with a continuous paper printout, shall be provided and used to record negative pressure. The instrument(s) shall have an alarm available.
 - C. Respirators shall be selected from those approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services. These respirators include:

1. Powered Air Purifying Respirator (PAPR) with NIOSH rated filters for asbestos and full facepiece; and rechargeable batteries.
 2. Type C Respirators with an Air Supply System that will provide Grade D breathing air in accordance with OSHA 29 CFR 1910.134 and ANSI 286.1-1973 Commodity Specification for Air. Each person using this system shall have an escape container of adequate capacity to allow escape from contaminated areas in the event of compressor failure. Compressors shall meet the requirements of 20 CFR 1910.134(d). The standard requires alarms to indicate compressor is used, it shall have a high temperature or carbon monoxide alarm, or both. If only a high temperature alarm is used, the air from the compressor shall be frequently tested for carbon monoxide to insure that it meets the required specifications.
 3. NIOSH-approved Dual Cartridge negative pressure air-purifying respirator, using NIOSH approved filters for asbestos or approved equal.
- D. Workers and authorized visitors exposed to airborne concentrations of asbestos fibers shall be provided with disposable protective whole body clothing, headcoverings, and foot coverings, use of tape. Protective clothing shall be provided to all workers and authorized visitors in sizes adequate to accommodate movement without tearing.
- E. Goggles shall be provided in accordance with ANSI Z87.1 to personnel engaged in certain asbestos operations when a full face respirator is not required.
- F. Ground fault circuit interrupters (GFCI) shall be provided for all electrical equipment, to be installed outside the work area so that there is no live electrical wiring not protected by GFCI inside the work area.

2.03 ENCAPSULANTS

- A. A spray type encapsulant shall be used as a lockdown of exposed surfaces and piping. The encapsulant shall be able to withstand heat and have the capacity to be applied pre-heated. No encapsulants will be applied until after satisfactory visual inspection of the work by the Consultant.

2.04 ELECTRICAL

- A. All electrical installations shall be accomplished under the direction of a Licensed Master Electrician.
- B. The Contractor shall furnish and install a portable GFI Power Supply Board and receptacles including the following:
1. All circuits individually GFI-protected;
 2. Weatherproof enclosure NEMA 3 (rain-tight) with receptacle covers;
 3. Construction durable, 16-gauge steel construction;

4. At least two 20-amp circuits (for Abatement Monitor);
 5. Main circuit breaker; and
 6. Components UL listed.
- C. The Decontamination Facility shall be furnished with power supply board with one 20-amp circuit (APM),
- D. The Contractor shall furnish and install wiring as follows:
1. Each 20-amp circuit for the Abatement Monitor shall have one run of 20-amp duplex outlets (watertight) each on 100 feet of No. 12 SO cord.
 2. Size the wire to limit voltage drop to a maximum of 3% with length of run.
- E. The Contractor shall supply temporary lighting for all abatement work areas.
- F. The Contractor shall de-energize, lock-out, and tag existing electrical components within the work area at their closest main source.
- G. The Contracting Officer will furnish electrical power for the project.

PART 3: EXECUTION

3.01 WORKER PROTECTION

- A. General:
1. All asbestos abatement work shall be performed in accordance with 29 CFR 1910.1001, 29 CFR 1926.1101, 453 CMR 6.00 and as specified herein. Personnel shall wear and utilize protective clothing and equipment as specified herein. Eating, smoking, drinking, chewing gum, or applying cosmetics shall not be permitted in the asbestos control area. Smoking shall not be permitted in the project buildings. Personnel of other trades not engaged in the abatement of asbestos shall not be allowed in the work area unless all the personnel protection provisions of this specification are complied with by the trade personnel.
 2. Engineering controls shall be used to minimize the airborne fiber concentration within the work area. A HEPA filtered exhaust unit shall be used to maintain a negative pressure within the work area of 0.02 inches of water. A combination of personal protective equipment and work practices shall also be used to further reduce employee exposure to asbestos fibers.
 3. The Contractor shall provide all authorized visitors with respirators, new filters, protective clothing, headgear, eye protection, footwear, and hard hats as in the

procedures described herein and afford them the use of all facilities to hold them free of contamination of asbestos fibers.

4. The Contractor shall provide the decontamination and work procedures to be followed by workers, as well as the results of the personal air monitoring. This information must be posted in the clean room.

B. Respiratory Protections:

1. The Contractor shall select and provide at no cost to his/her employee respirators which shall provide adequate protection to the employee as specified by Section 1910.1001(g) Table D-1 and Section 1926.1101(h) Table D-4.
2. Respiratory protection shall be worn by all persons potentially exposed to asbestos from the initiation of the asbestos abatement project until all areas have been given clearance. Clearance shall be obtained by visual observation and air monitoring conducted by the Abatement Monitor.
3. Until the Contractor establishes, through collection and analysis of personal air samples in accordance with the OSHA Reference Method (ORM) (See U.S. Department of Labor; Occupational Safety and Health Administration; Occupational Exposure to Asbestos; Title 29 CFR 1910.1001, "General Industry Standard." Title 29 CFR 1926.1101, "Construction Standard", that the average airborne concentrations of asbestos the employees will confront will not exceed 100 times the permissible exposure limits, Powered Air Purifying Respirators or Type C (continuous flow or pressure demand) supplied air respirators shall be used.
 - a. Once the exposure limits have been established, the respirators presented in 29 CFR 1910.1001 that afford adequate protection at such upper concentrations of airborne asbestos fibers shall be used.
 - b. The minimum personal sampling period shall be seven hours at a flow rate of two liters per minute. The sample shall be collected within the workers breathing zone. Personal sampling shall be the responsibility of the Contractor. Personal sampling results shall be available on site no later than 24 hours after sampling.
 - c. The filters provided for both the cartridge respirators and the PAPR's shall be NIOSH approved for asbestos fibers.

C. Protective Clothing:

1. The Contractor shall provide to all workers, foreman and superintendents, protective disposable clothing consisting of full body coveralls, head covers, and 18-inch high boot type covers or reusable footwear.

2. The Contractor shall provide eye protection and hard hats as required by job conditions and safety regulations.
3. Reusable footwear, hard hats and eye protection devices shall be left in the "contaminated equipment room" until the end of the asbestos abatement work.
4. Upon completion of asbestos abatement, the footwear shall be disposed of as contaminated waste or cleaned thoroughly inside and out using soap and water before removing from work area or from equipment and access area.
5. All disposable protective clothing shall be discarded and disposed of as asbestos waste when the wearer exits from the work space to the outside through the decontamination facilities.
6. The color of the disposable clothing worn outside the work area shall be a different color than the disposable clothing worn inside the work area.

D. Decontamination Procedures:

1. Each worker and authorized visitor without exception shall, upon entering the job site: remove street clothes in the clean change room and put on an appropriate respirator with new filters, and clean disposable protective clothing before entering the equipment room or the work area, except that workers intending to rewear previously worn protective clothing stored in the equipment room shall enter the equipment room wearing only respirators.
2. Each time he/she leaves the work area, each worker and authorized visitor shall:
 - a. Vacuum gross contamination from clothing before leaving the work area.
 - b. Proceed to the equipment room and remove all clothing except respirator.
 - c. Still wearing the respirator proceed naked to the showers.
 - d. Clean the outside of the respirator with soap and water while showering.
 - e. Remove filters and wet them and dispose of filters in the container provided for the purpose.
 - f. Wash and rinse the inside of the respirator. After showering, dry off with disposable towels.
3. Following showering and drying off, each worker and authorized visitor shall proceed directly to the clean change room and dress in street clothes at the end of the day's work, or before eating, smoking, or drinking.

4. Contaminated reusable work footwear shall be stored in the equipment room when not in use in the work area. Upon completion of asbestos abatement, footwear shall be disposed of as contaminated waste or cleaned inside and out using soap and water before removing these items from work area or from equipment and access area. Contaminated protective clothing shall be stored in the equipment room for reuse or placed in receptacles for disposal with other asbestos contaminated materials.

3.02 WORK PREPARATION

- A. Protection of Existing Work to Remain: The Contractor shall perform demolition work without damage or contamination of adjacent work areas. Where such work area is damaged or contaminated it shall be restored to its original condition immediately.
- B. Work Areas:
 1. The Contractor shall isolate the abatement area and shall erect signs around the perimeter in accordance with EPA, OSHA and this specification. The Contractor shall maintain a log of people entering and exiting the workplace.
 2. Signs shall be posted by the Contractor at approaches to any asbestos control area. Signs shall be posted at a distance sufficiently far enough away from the work area to permit an employee to read the sign and take the necessary protective measures to avoid exposure. Additional signs may need to be posted following construction of workplace enclosure barriers. DO NOT ENTER signs shall also be posted.
 3. When necessary, and if possible, the Contractor shall shut down electric power to ACM removal areas. The Contractor is responsible for providing lock-out and tag-out of de-energized electrical system.
 4. The Contractor shall seal off openings in the walls, ceilings, and floor from inside the work area leading to outside areas by covering them with two layers of 6-mil polyethylene and duct tape.
 5. The Contractor shall seal doorways, drains, ducts, grills, grates, and other openings between the work area and uncontaminated area outside the work area. These critical areas shall be sealed with two layers of 6-mil polyethylene sheeting and tape.
 6. The Contractor shall seal metal ducts, metal heater boxes and intake areas with two layers of polyethylene or some other means acceptable per this specification.
 7. The Contractor shall preclean the work area by removing any loose, gross debris after construction of critical barriers and installation of decontamination facility and negative air system.

8. The Contractor shall preclean fixed and movable objects in the work area using HEPA filtered vacuums and/or wet cleaning techniques as appropriate including:
 - a. Machinery behind grilles or gratings.
 - b. Wall, floor and ceiling penetrations behind fixed items.
9. After precleaning, the Contractor shall enclose fixed objects in 6-mil polyethylene sheeting and seal with tape.
10. After precleaning furniture and equipment, the Contractor shall remove these items from the area if possible.
11. Electrical items shall be sealed by the Contractor to avoid water/moisture damage. Electrical equipment shall be completely covered with a minimum of two layers of plastic (6 mil minimum), each taped and sealed. Electrical equipment shall be de-energized, locked, and tagged-out prior covering.

3.03 ASBESTOS CONTROL AREA CONSTRUCTION

- A. The Contractor shall construct a polyethylene barrier system to enclose the work area which shall include:
 1. Two layers of 4-mil polyethylene for wall surfaces and two layers of 6-mil polyethylene sheeting on the floors.
 2. For areas involving tunnels between removal areas, a double layer of 6 mil polyethylene sheeting will be used on the top, floor and sides. Certain areas of the tunnels will require solid plywood barriers for temporary walls.
 3. Emergency breakthrough points on the polyethylene shall be clearly marked and always accessible. Arrows to emergency exits shall be placed 2 feet off the floor.
 4. Emergency and fire exits shall be maintained from the work area, or establish alternative exits satisfactory to fire officials.
 5. Clear acetate windows shall be installed at strategic locations in the enclosure system to allow for observation of the abatement process from outside of the work area.

3.04 DECONTAMINATION FACILITY

- A. For each abatement area the Contractor shall provide decontamination facilities located in an area agreed upon as part of the approved Asbestos Abatement Plan. The decontamination facilities shall include a decontamination enclosure system for workers and visitors and an equipment decontamination enclosure system.

- B. The decontamination enclosure system shall consist of three rooms separated by air locks as follows: clean room at entrance followed by an airlock, a shower room followed by an airlock, and a decontamination area/equipment room leading to the work area. Typical airlock length from the end of one chamber to the beginning of the next chamber shall be a minimum of 3 feet in length using layers of polyethylene.
- C. The clean room shall have one curtained doorway into the airlock and one (1) entrance or exit to non-contaminated areas of the building. The clean room shall have sufficient space for storage of the workers' street clothes, towels, and other non-contaminated items. Joint use of this space for other functions such as offices, storage of equipment, materials, or tools is prohibited.
- D. The shower room shall have two curtained doorways, one (1) to each airlock. Poly on shower room and adjoining equipment and clean rooms shall be non-transparent. Showers shall be provided and used at all asbestos removal operations. The shower drain will be equipped with a 5 micron filter.
- E. The shower room shall contain at least one (1) shower with hot and cold or warm water. A supply of soap and disposable towels shall be provided in the shower room.

3.05 MAINTENANCE OF THE WORK AREA

- A. The Contractor shall install exhaust ventilation for the work area to maintain a negative pressure of 0.02 inches of water. A HEPA filter is required. If negative air pressure of 0.02 inches is lost, work should be halted until negative air pressure is restored. The exhaust ventilation system shall operate on a 24 hour basis throughout the abatement process and through the clearance air monitoring. The exhaust ventilation system will be designed in accordance with EPA recommendations included in the "Guidance for Controlling Friable Asbestos - Containing Materials in Buildings". Exhaust ventilation units should be exhausted to the outside of the building.
- B. The Contractor shall provide an automatic recording instrument to monitor the negative pressure differential with the sensor located at a point approved by the Abatement Monitor. The permanent record shall be turned over to the Abatement Monitor at the beginning of each work day to become part of the project documentation records. If negative air pressure of 0.02" is lost, work shall be halted until negative air pressure is restored.
- C. The Contractor shall provide a sufficient number of exhaust ventilation units to create a flow of air from supply air opening toward the exhaust ventilation units to avoid dead air pockets.
- D. Acceptance of Asbestos Control Area: The Contractor shall not begin precleaning unless the Abatement Monitor is in attendance. The control area must be constructed, the exhaust ventilation units put in place, the decontamination area prepared and the supplies to be used have been assembled, barriers are properly constructed, that wall and ceiling openings are sealed, that 0.02 inches of water negative pressure has been achieved and that other preparations have been made to allow the removal operation to proceed. If

conditions are not acceptable, Contractor shall correct deficiencies to comply with the specifications.

3.06 ABATEMENT METHODS

A. Removal :

1. The asbestos shall be removed in a wet state (See 40 CFR Part 61, Sub Part M. See 61.147).
2. The Contractor shall adequately wet asbestos containing material with an amended water solution using equipment capable of providing a fine spray mist in order to reduce airborne fiber concentrations when the material is disturbed. The material shall be saturated to the substrate; however, do not allow water to accumulate in the work area. The Contractor shall maintain removed material adequately wet to reduce fiber release until it can be containerized for disposal. A high humidity shall be maintained in the work area by misting or spraying to assist in fiber settling and reduce airborne concentrations - Do not use amended water to comply with this section.
3. Saturated asbestos-containing material shall be removed in manageable sections.
4. The Contractor shall double bag or double wrap waste material in 6-mil polyethylene plastic. If bags are used, they will not be overfilled and shall be securely sealed to prevent accidental opening and leakage by taping tops of bags in an overhand knot or by taping in gooseneck fashion. Bags shall not be sealed with wire or cord. If materials are wrapped in polyethylene plastic, two independent layers of plastic sheeting will be required with each layer independently taped and glued securely.
5. All removed materials will be wrapped or bagged for waste transport by the end of each work shift. No uncontainerized materials will be allowed to remain past the end of a work shift.
6. During this work the surfaces being cleaned shall be kept wet.
7. Evaluation During Removal: While performing asbestos removal work, the Contractor will be subject to periodic evaluation and observation by the Abatement Monitor who may be assisted by other safety or health personnel. If items of the asbestos removal work that are found to be in violation of this specification, the Abatement Monitor may recommend the Contracting Officer issue a stop work order to be in effect until the violation is resolved. Standby time required to resolve the violation will be at the Contractor's expense. Also, if the fiber count inside the containment area goes over 0.50 fiber/cc or the negative air pressure in the containment area drops below 0.020 inch of water, the job may be shut down and corrective actions taken prior to continuing. Shut down may also occur if airborne fiber concentrations are found to be in excess of 0.01 f/cc in the clean room and outside areas; a break occurs in the containment barrier;

failure of workers to wear respiratory protection; or poor housekeeping inside or outside the contained area.

3.07 FINAL CLEAN UP AND INSPECTION PROCEDURE

- A. After the removal and encapsulation of asbestos has been completed and before removal of barriers, piping and all other surfaces within the work area shall be thoroughly wet cleaned and/or vacuumed. Waste containers (except those necessary for final cleanup) and non-essential tools shall be packed, cleaned, and removed from the work area prior to final cleanup and monitoring.
- B. From this point to lockdown, the Abatement Monitor will be in constant attendance.
 - 1. The Abatement Monitor will evaluate the work area for visible material. The Contractor shall reclean if necessary. After acceptance, remove the inner layer of polyethylene, leaving one layer and critical barriers. The Contractor shall clean the walls, floors, and ceilings. Lockdown will not be permitted at this time.
 - 2. The Abatement Monitor will evaluate the work area.
 - 3. If the area passes the evaluation, apply lockdown, except for external work areas. After the lockdown has dried, the Abatement Monitor will perform the final aggressive clearance. The samples will be analyzed by the NIOSH Method 7400 with a clearance criteria for all samples of less than 0.01 fiber/cc.
- C. Clearance air monitoring will be conducted in accordance with the protocol established in Section 01410-Testing Laboratory Services.
- D. Responsibility for Damages: Any damage to the finishes, floor, walls or any other items or fixtures that results from actions by the Contractor's personnel shall be repaired to match the original condition by the Contractor without any additional cost to the Contracting Officer.

3.08 DISPOSAL

- A. All waste material shall be promptly wetted and placed in 6-mil polyethylene bags or wrapped in two layers of 6-mil polyethylene plastic sheeting as it is generated. A sufficient number of waste bags and/or plastic sheeting shall be located in the immediate work area and in the equipment room of the decontamination facility (unused bags in the equipment room must be disposed of as contaminated waste). The Contractor shall count or measure the volume of each filled container leaving the work area, and maintain a written record of such.
- B. Warning labels, having waterproof print and permanent adhesive, shall be affixed to the sides of all waste bags or transfer containers. Warning labels shall be conspicuous and legible, and contain the following words in accordance with OSHA 1926.1101:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

In addition to the above, include the generators name and address on each waste container. Waste transport vehicles will have appropriate U.S. Department of Transportation signage on them for transportation of asbestos waste materials.

- C. A fine water spray shall be used to keep the unbagged or unwrapped waste damp at all times.
- D. Sealed waste shall be removed from the work area and stored in an on-site, enclosed and locked dumpster or transported to the landfill or off-site temporary storage until a truckload quantity is obtained. The temporary storage dumpster area shall be prominently identified and be kept locked.
- E. Once a truckload of waste containers has accumulated, the Contractor shall arrange for transportation to the landfill. No temporary off-site storage or off-site co-mingling of asbestos waste from this project site will be allowed.
- F. Waste Transportation and Disposal Regulations:
 - 1. It is the responsibility of the Contractor to determine and ensure compliance with the current waste handling regulations applicable to the work site and the current regulations for waste transportation to and disposal at each ultimate landfill. The Contractor shall comply fully with these regulations and with all U.S. Department of Transportation and EPA requirements.
 - 2. If required, the Contractor (or subcontractor), at no additional cost, shall maintain a valid hazardous waste transporter's permit and identification number, and document and fully comply with any hazardous waste manifesting requirements.
- G. Waste Disposal Procedure:
 - 1. The Contractor shall incorporate in his/her proposal the estimated quantity of asbestos waste disposal to be generated during the work; the proposed final waste site; the estimated number of separate waste shipments (loads), and the current estimated transportation and landfill disposal fees (per cubic yard). Non-contaminated waste transport and disposal shall be solely the Contractor's responsibility. The Contractor shall review each of these items and resolve any discrepancies or deficiencies during the pre-construction site meeting.
 - 2. The Contractor shall package, label, and remove all asbestos waste as specified in the specifications. Packaging shall be accomplished in a manner that minimizes waste volume, but so that waste containers will not tear or break.

3. The Contractor shall request, in advance, the Consultant to review the total volume of waste material to be removed from the site (total count of waste containers and total volume estimate to the nearest 0.5 cubic yard), and insert the quantity on the Waste Shipment Record (Appendix A) and on a hazardous waste manifest if required.
4. The Contractor shall provide legal transportation of this waste to the ultimate disposal landfill; and have the waste hauler and the landfill Contracting Officer complete all other required manifests, dump slips, or other forms. The completed and fully signed (by all required parties) original of the Waste Shipment Record, and copies of the other forms, shall be returned within thirty (30) calendar days to the Consultant for payment approval. No payments will be approved, or made for incomplete Waste Shipment Records.
5. Waste may be transported to and temporarily stored at a pre-approved off-site storage area owned by the Contractor, but it shall ultimately be disposed of at the specified landfill within 30 calendar days before any payments are made.

H. Waste Disposal Fees: All contaminated waste handling costs, such as waste packaging, on-site/off-site storing/handling, transport/disposal, permitting, record keeping, and non-contaminated waste handling shall be included in the Contractor's proposal as applicable to removal of asbestos materials and/or performance of the related abatement activities.

3.09 PROJECT RESTORATION

A project walk-through will be conducted after the abatement portion of the project to identify areas or equipment damaged during the work. If the Contracting Officer determines that the damage is caused by acts or omissions of the Contractor, a punch list shall be developed. The Contractor will be responsible for repair or replacement, or at the discretion of the Contracting Officer, payment for the work of another Contractor to complete the punch list. A second walk through will be conducted after completion of punch list items.

END OF SECTION

SECTION 02273 - EROSION CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. The work included for erosion control shall include but not necessarily be limited to:
 - 1. Furnishing and installation of straw bales, grading to control runoff, and all other devices required to control erosion.
 - 2. Continual maintenance of all installed devices to control erosion.
 - 3. Removal and clean-up.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for soil disturbance and grading.
 - 2. Division 2 Section "Site Clearing" for site stripping, grubbing, removing topsoil, and protecting trees to remain.

1.04 DEFINITIONS – Not Used

1.05 SUBMITTALS

- A. Implementation Plan

Prior to commencement of the work, the Contractor shall:

- 1. Meet with the Contracting Officer to develop mutual understandings relative to compliance with the provisions of this Section and administration of the erosion and sediment control program.
- 2. Should the Contractor desire to change or modify the specified erosion controls then he shall submit in writing his plans to the Government for implementing erosion and sediment control including, but not limited to, placement of hay bales, silt fence, mulch and temporary channels, as well as a description of all construction techniques intended to minimize erosion and sedimentation, and a program for maintenance of these facilities throughout the performance of construction activities.
- 3. The Contractor, should he desire to modify the specified plan, shall submit to the Government and Contracting Officer his detailed erosion and sedimentation plan for approval at least two weeks prior to initiation of work.

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1.06 QUALITY ASSURANCE

- A. Conduct all construction in a manner and sequence that causes the least practical disturbance of the physical environment.
- B. Stabilize disturbed earth surfaces in the shortest practical time and employ any and all such temporary erosion control devices as may be necessary until such time as adequate soil stabilization has been achieved or permanent erosion control devices are operational.
- C. The erosion control devices specified herein represent the minimum required work for erosion control. The Contractor shall add to these minimum devices any and all measures to effectively prevent migration of sediment from the work area.

1.07 PROJECT CONDITIONS

- A. In order to prevent erosion and sedimentation from construction activities related to the performance of this project, the Contractor and his subcontractors shall comply with permits issued for the project, all applicable federal, state and local laws and regulations concerning erosion and sediment control, as well as the specific requirements stated in this Section and elsewhere in the Specifications.

PART 2 - PRODUCTS

2.01 STRAW BALES

- A. Bales shall be made of hay with forty pounds minimum weight and one hundred and twenty pounds maximum weight. They should be either wirebound or string tied. Wood stakes shall be a minimum of 2 inches by 2 inches nominal size by a minimum of 3 feet long.

2.02 TEMPORARY COVER

- A. Temporary Mulching - Mulches will consist of organic material such straw, shredded corn stalks, wood chips, bark or shavings, excelsior and wood fiber. Wood chips or bark mulch must be at least 50% decomposed for use as mulch. Mulch may also consist of erosion control blankets and mats designed and manufactured specifically for the purpose of soil retention.

PART 3 - EXECUTION

3.01 GENERAL EROSION CONTROL REQUIREMENTS

- A. All materials and installation shall be in accordance with the approved erosion and sediment control plan.

- B. The Government has the authority to control the surface area of each material exposed by construction operations and to direct the Contractor to immediately provide permanent or temporary erosion control measures to prevent contamination of adjacent storm drainage systems, watercourses, ponds or other areas of water impoundment. Every effort shall be made by the Contractor to prevent erosion on the site.
- C. The erosion control features installed by the Contractor shall be maintained by the Contractor, and he shall remove such installations upon completion of the Work or if ordered by the Government.
- D. The Contractor shall operate all equipment and perform all construction operations so as to minimize pollution. The Contractor shall cease any of his operations which will increase pollution during rain storms.
- E. The Contractor shall place additional erosion and sedimentation controls as required by laws and regulations.

3.02 SEEDING

- A. Temporary Mulching - Temporary mulching will be used on all planted surfaces to maintain surface stability until the vegetation becomes established. Mulching will also be used to stabilize surfaces during the off-season pending planting during the growing season.
- B. Organic mulches will be spread uniformly, by hand or machine and will be anchored to the soil surface by netting, pegs and twine, or cut into the soil surface with anchoring tools (spade or disk) to a depth of about 3 inches. Where hydromulching is used in seeding surfaces, the application rate will be 1,500 pounds per acre on flats and 3,000 pounds per acre on slopes. Erosion control blankets and mats will be installed and secured in accordance with the manufacturer's specifications.
- C. Mulch maintenance will consist of periodic inspection, particularly after rainstorms, for, erosion damage to mulch cover, failure of anchoring mechanisms, washouts, dislocation or other failures. Where any of these conditions is observed, the damage will be repaired and the mulch will be replaced and reanchored as needed. Inspections will continue until vegetative cover is established as indicated by grasses of uniform height and density at a minimum height of three inches.

3.03 STRAW BALE INSTALLATION

- A. Bales shall be set lengthwise on the contour for sheet flow applications. They shall be held in place by two wooden stakes in each bale as detailed. Bales shall be maintained or replaced until they are no longer necessary for the purpose intended or are ordered removed by the Government.

- B. After the bale end joints shall be chinked with loose straw to close any gaps. Excavated soil shall then be backfilled against the uphill side of the barrier to a depth of 4 inches above the downhill grade.
- C. Following compaction of the backfill, loose straw shall be scattered over the surface directly behind the barrier.

3.04 DIVERSIONS

- A. Diversions for directing surface runoff or existing stream to allow sediment removal away from and/or around excavating and other construction operations shall be installed and stabilized in advance of new work.
- B. The minimum capacity of the diversion shall be sized to accommodate a 2-year design storm.
- C. Periodic cleaning shall be done to maintain capacity.

3.05 MAINTENANCE

Contractor shall remove sediment which has built up to half the height of the straw bales. Reset bales as necessary.

3.06 REMOVAL AND CLEAN-UP

- A. All temporary erosion control facilities and accumulated sediments, shall be removed in a neat and workmanlike manner when all disturbed areas have been satisfactorily stabilized.
- B. All debris removed, sediments and other earth materials shall not leave the project site, but shall be hauled to and stockpiled at the location designated by the Government. All loading, hauling and stockpiling shall be performed by the Contractor at no additional expense.

END OF SECTION 02273

SECTION 02300 - EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. The Connecticut Department of Transportation, Standard Specifications for Roads, Bridges and Incidental Construction, latest edition, including all amendments and revisions, hereinafter referred to as the Connecticut Standard Specifications.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns, and plantings.
 - 2. Excavating and backfilling for utilities, buildings and structures.
 - 3. Drainage course for slabs-on-grade.
 - 4. Subbase course for concrete walks and pavements.
 - 5. Base course for pavement.
 - 6. Sediment and erosion control.
 - 7. Excavating and backfilling trenches within building lines.
 - 8. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.
- B. Related Sections include the following:
 - 1. Division 2 Section "Site Clearing" for site stripping, grubbing, removing topsoil, and protecting trees to remain.

1.3 UNIT PRICES

- A. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.
 - 1. 6 inches (150 mm) outside of concrete forms.
 - 2. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
 - 3. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - 4. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
 - 5. 6 inches (150 mm) beneath pipe in trenches, and the greater of 12 inches (300 mm) wider than pipe or 42 inches (1065 mm) wide.

6. Boulders within building limits greater than 2.0 cubic feet (0.37 cubic meters) or 325 pounds (147 kg) will be measured as rock for payment purposes.

1.4 DEFINITIONS

- A. Backfill: Soil materials 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: Layer placed between the subbase course and pavement.
- C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations.
 1. Additional Excavation: Excavation below subgrade elevations as directed by Contracting Officer. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 2. Bulk Excavation: Excavations more than 10 feet (3 m) in width and pits more than 30 feet (9 m) in either length or width.
 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Contracting Officer. Unauthorized excavation, as well as remedial work directed by Contracting Officer, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits that when tested by an independent geotechnical testing agency, according to ASTM D 1586, exceeds a standard penetration resistance of 100 blows/2 inches (97 blows/50 mm).
- I. 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.
- J. Subbase Course: Layer placed between the subgrade and base course for asphalt paving and aircraft concrete pavement, or layer placed between the subgrade and a concrete walk.
- K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

- L. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings limits.

1.5 SUBMITTALS

- A. Product Data: For the following:

- 1. Each type of plastic warning tape.

- B. Samples: For the following:

- 1. 30-lb (14-kg) samples, sealed in airtight containers, of each proposed soil material from on-site or borrow sources.

- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

- 1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
- 2. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill.
- 3. California Bearing Ratio (CBR) results according to ASTM D 1883 for borrow for Airfield Pavement Base Course and Subbase Course.

- D. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

1.6 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

- B. Preexcavation Conference: Conduct conference at Project site to comply with requirements in of the General Contractor.

- C. Conduct all construction in a manner and sequence that causes the least practical disturbance of the physical environment.

- D. Stabilize disturbed earth surfaces in the shortest practical time and employ any and all such temporary erosion control devices as may be necessary until such time as adequate soil stabilization has been achieved or permanent erosion control devices are operational.

- E. The erosion control devices specified herein represent the minimum required work for erosion control. The Contractor shall add to these minimum devices any and all measures to effectively prevent migration of sediment from the work area.

1.7 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted in writing by Contracting Officer and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Contracting Officer not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Contracting Officer's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies and the Contracting Officer to shut off services if lines are active.
- C. In order to prevent erosion and sedimentation from construction activities related to the performance of this project, the Contractor and his subcontractors shall comply with permits issued for the project, all applicable federal, state and local laws and regulations concerning erosion and sediment control, as well as the specific requirements stated in this Section and elsewhere in the Specifications.

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: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Backfill and Fill: Satisfactory soil materials.
- E. Subbase: 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 (38-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- F. Base: Artificially graded and washed mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; conforming to the requirements of M.05.01, Processed

Aggregate Base, of the Connecticut Standard Specifications with not more than 8 percent passing a No. 200 (0.075-mm) sieve and a California Bearing Ratio (CBR) of not less than 70.

- G. Structural 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 (38-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- H. Bedding: For pipe bedding and other locations as indicated and specified, 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 (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

2.2 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.

2.3 SEDIMENT SACKS FOR DRAIN INLETS

- A. Sediment sacks shall be fabricated with seams and reinforcing bands sufficient to support the full weight of the sack filled with wet sediment.
- B. The sediment sack shall have rolled edges, loops for insertion of rods or other means of preventing the sack from slipping between the grate and frame while allowing vehicles to safely pass over the structure.
- C. Sediment sacks shall have integral lifting loops or other positive means for holding and lifting the sack from the drain inlet for cleaning and removal.
- D. Sediment sacks shall be installed prior to stripping of topsoil, clearing and grubbing, removal of pavements or any other earth-disturbing activities.
- E. Sediment sacks shall be inspected weekly throughout construction and immediately following any rain event which produces 0.5 inches (12 mm) or more precipitation in a 24 hour period.
- F. Sediment shall be removed from sacks prior to the depth of sediment reaching one-half of the conical depth measured from the base of the grate to the inside bottom of the sack. Reset or replace sediment sacks as necessary.

- G. The Contractor shall be responsible to repair, at no additional cost to the Government, any damage caused by failure to maintain the sacks and/or promptly remove accumulated sediment.
- H. All temporary erosion control facilities and accumulated sediments, shall be removed in a neat and workmanlike manner when all disturbed areas have been satisfactorily stabilized.
- I. All debris removed, sediments and other earth materials shall be removed from Government property. All loading, hauling and disposal shall be performed by the Contractor at no additional expense.

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 earthwork operations.
- B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

- A. Explosives: Use of explosives will not be permitted.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavation outside of building shall be unclassified excavation regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
- B. Classified Excavation: Inside of the exterior building foundation walls, excavation will be classified for the purpose of payment.
- C. Within the building foundation limits, rock shall be removed by drilling, chipping, splitting or other approved means. The Contractor shall take necessary measures to control noise and dust.

3.5 EROSION AND SEDIMENT CONTROL

- A. Install straw bales at existing catch basins and drain inlets as detailed. Straw bales shall be maintained or replaced until they are no longer necessary for the purpose intended or are ordered removed by the Government.

3.6 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). 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. 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 (25 mm). Do not disturb bottom of excavations intended for bearing surface.

3.7 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.8 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.
 1. Clearance: 12 inches (300 mm) on each side of pipe or conduit.
 2. Clearance: As indicated.

- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade. Place bedding material to required limits.
 - 1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - 2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill or compacted bedding material.
 - 3. Excavate trenches to allow for 8 inches (150 mm) of bedding course.

3.9 APPROVAL OF SUBGRADE

- A. Notify Contracting Officer when excavations have reached required subgrade.
- B. If Contracting Officer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
 - 1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Contracting Officer.

3.10 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Contracting Officer.
 - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Contracting Officer.

3.11 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.12 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for record documents.
 - 3. Inspecting and testing underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.13 UTILITY TRENCH BACKFILL

- A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- B. Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings; fill with concrete to elevation of bottom of footings.
- C. Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit.
 - 1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- D. Coordinate backfilling with utilities testing.
- E. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.
- F. Place and compact final backfill of satisfactory soil material to final subgrade. Beneath aircraft pavement backfill with base course as detailed.
- G. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.14 FILL

- A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.
- B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- C. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use structural fill.
4. Under building slabs, use structural fill.
5. Under footings and foundations, use structural fill.

3.15 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
 1. Do not place backfill or fill 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.

3.16 COMPACTION OF BACKFILLS AND FILLS

- A. Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil 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 (300 mm) of existing subgrade and each layer of backfill or fill material at 95 percent.
 2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 92 percent.
 3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 85 percent.

3.17 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch (25 mm).
2. Walks: Plus or minus 1 inch (25 mm).
3. Pavements: Plus or minus 1/2 inch (13 mm).

- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.18 SUBSURFACE DRAINAGE

NOT USED

3.19 SUBBASE AND BASE COURSES

- A. Under pavements and walks, place subbase course on prepared subgrade and as follows:

1. Place base course material over subbase.
2. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
3. Compact Base Course beneath Aircraft Pavement to not less than 100% of the maximum dry unit weight according to ASTM D 1557.
4. Shape subbase and base to required crown elevations and cross-slope grades.
5. When thickness of compacted subbase or base course is 6 inches (150 mm) or less, place materials in a single layer.
6. When thickness of compacted subbase or base course exceeds 6 inches (150 mm), place materials in equal layers, with no layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick when compacted.

- B. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.20 FIELD QUALITY CONTROL

- A. Testing Agency: Government will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Contracting Officer.

- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests per lift.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet (30 m) or less of wall length, but no fewer than two tests.
 - 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet (46 m) or less of trench length, but no fewer than two tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.21 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 Contracting Officer; 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 the greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Government's property.

END OF SECTION 02300

SECTION 02510 - WATER DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes water-distribution piping and specialties outside the building for the following:
 - 1. Water service and fire-service mains.
 - 2. High pressure fire service mains.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.3 DEFINITIONS

- A. Water Service and Fire-Service Main: Exterior water piping for domestic-water piping.
- B. High Pressure Fire Service Main: Exterior water piping for fire suppression piping, 175 psi operating pressure.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Valves and accessories.
- B. Coordination Drawings: For piping and specialties including relation to other services in same area. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- C. Field Quality-Control Test Reports: From Contractor.
- D. Operation and Maintenance Data: For specialties to include in emergency, operation, and maintenance manuals, include the following:
 - 1. Valves.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of piping and specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Regulatory Requirements:

1. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

1.7 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Contracting Officer not less than two days in advance of proposed utility interruptions.

1.8 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint, bell- and plain-spigot end unless grooved or flanged ends are indicated.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint, bell- and plain-spigot end unless grooved or flanged ends are indicated.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber.

2.4 CORROSION-PROTECTION ENCASUREMENT FOR PIPING

- A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch (0.20-mm) minimum thickness, tube or sheet.

2.5 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves:
 - 1. Available Manufacturers:
 - a. American AVK Co.; Valves & Fittings Div.
 - b. American Cast Iron Pipe Co.; American Flow Control Div.
 - c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.

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- d. Crane Co.; Crane Valve Group; Stockham Div.
- e. East Jordan Iron Works, Inc.
- f. Grinnell Corporation; Mueller Co.; Water Products Div.
- g. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
- h. McWane, Inc.; Kennedy Valve Div.
- i. McWane, Inc.; Tyler Pipe; Utilities Div.
- j. NIBCO INC.
- k. United States Pipe and Foundry Company.

2.6 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," bottom section with base of size to fit over valve, and approximately 5-inch- (125-mm-) diameter barrel.
 - 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- C. Do not use flanges, unions, or keyed couplings for underground piping.
- D. Flanges, unions, keyed couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground Water-Service Piping: Use any of the following piping materials for each size range:
 - 1. NPS 5 and NPS 6 (DN 125 and DN 150): Use NPS 6 (DN 150) PVC, AWWA Class 200 pipe; PVC, AWWA Class 200 fabricated push-on-joint, ductile-iron mechanical-joint, ductile-iron fittings; and gasketed joints.
- F. Underground Combined Water-Service and Fire-Service-Main Piping: Use the following:
 - 1. NPS 6 to NPS 12 (DN 150 to DN 300): Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed or mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

2. NPS ¾ to NPS 2 (DN 20 to DN 50): Soft copper tube, Type K (Type A); wrought-copper fittings; and soldered joints.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 (DN 80) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FM, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 (DN 50) and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Underground Valves, NPS 3 (DN 80) and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.

3.4 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
 1. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

3.5 PIPING INSTALLATION

- A. Water-Main Connection: Connect to existing water main according to requirements of water utility company and of size and in location indicated.
- B. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.

3.6 ANCHORAGE INSTALLATION

- A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 1. Fire-Service-Main Piping: According to NFPA 24.
- B. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

3.8 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

- B. Hydrostatic Tests: Test at not less than 1-1/2 times working pressure for 2 hours.
 - 1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

3.9 IDENTIFICATION

- A. Install continuous underground warning tape during backfilling of trench for underground water-service piping. Locate below finished grade, directly over piping. See Division 2 Section "Earthwork" for underground warning tapes.
- B. Permanently attach equipment nameplate or marker, indicating plastic water-service piping, on main electrical meter panel.

3.10 ADJUSTING

- A. Adjust drinking fountain flow regulators for proper flow and stream height.

3.11 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping or as described below. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 02510

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SECTION 02530 - SANITARY SEWERAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes sanitary sewerage outside the building.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for soil material, excavating, backfilling and site grading.
 - 2. Division 3 Section "Cast-in-Place Concrete" for concrete structures.

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

1.5 SUBMITTALS

- A. Shop Drawings: Include plans, elevations, details, and attachments for the following:
 - 1. Precast concrete manholes, including frames and covers.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic pipe and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
- B. Locate existing structures and piping to be closed and abandoned.

- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Contracting Officer not less than two days in advance of proposed utility interruptions.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.2 PIPES AND FITTINGS

- A. PVC Sewer Pipe and Fittings: According to the following:
 - 1. PVC Sewer Pipe and Fittings, NPS 15 (DN375) and Smaller: ASTM D 3034, SDR 35, for solvent-cemented or gasketed joints.
 - a. Gaskets: ASTM F 477, elastomeric seals.

2.3 MANHOLES

- 1. Precast Concrete Manholes shall conform with CTDOT Standard Specifications, latest edition, Section 5.07.
- B. Manhole Frames and Covers shall conform with CTDOT Standard Specifications, latest edition, Section 5.07.

2.4 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 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 (27.6 MPa) minimum, with 0.45 maximum water-cementitious materials ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 400), deformed steel.
- C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) 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.
 - b. Invert Slope: 2 percent through manhole.
 - 2. Benches: Concrete, sloped to drain into channel.

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- a. Slope: 8 percent.
- b. Slope: 4 percent.

- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water-cementitious materials ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 400), deformed steel.

2.5 PROTECTIVE COATINGS

- A. Description: One- or two-coat, bitumastic; 15-mil (0.38-mm) minimum thickness, unless otherwise indicated; factory or field applied to the following surfaces:
 - 1. Concrete Manholes: On exterior surface.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 IDENTIFICATION

- A. Materials and their installation are specified in Division 2 Section "Earthwork." Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.
 - 1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 PIPING APPLICATIONS

- A. General: Include watertight joints.
- B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.
- C. Gravity-Flow Piping: Use the following:
 - 1. NPS 6, NPS 8 and NPS 10 (DN150, DN200 and DN250): PVC sewer pipe and fittings, or gaskets and gasketed joints.

3.4 INSTALLATION, GENERAL

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.
- 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. Maintain swab or drag in line, and pull past each joint as it is completed.

- C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- D. Use 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. Install gravity-flow piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.
 - 1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
 - 2. Install piping with 36-inch (1000-mm) minimum cover.

3.5 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. General: Join and install pipe and fittings according to installations indicated.
- B. PVC Sewer Pipe and Fittings: As follows:
 - 1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
 - 2. Join profile sewer pipe fittings with gaskets according to ASTM D 2321 and manufacturer's written instructions.
 - 3. Install according to ASTM D 2321.

3.6 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Form continuous concrete channels and benches between inlets and outlet.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere, unless otherwise indicated.
- D. Install precast concrete manhole sections with gaskets according to ASTM C 891.
- E. Construct cast-in-place manholes as indicated.
- F. Install fiberglass manholes according to manufacturer's written instructions.

3.7 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.8 FIELD QUALITY CONTROL

- A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. Place plug in end of incomplete piping at end of day and when work stops.
 2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) 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. 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.
- C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to authorities having jurisdiction.
 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 4. Submit separate reports for each test.
 5. If authorities having jurisdiction do not have published procedures, perform tests as follows:
 - a. Sanitary Sewerage: Perform hydrostatic test.
 - 1) Allowable leakage is maximum of 50 gal. per inch of nominal pipe size per mile (4.6 L per millimeter of nominal pipe size per kilometer) of pipe, during 24-hour period.
 - 2) Close openings in system and fill with water.
 - 3) Purge air and refill with water.
 - 4) Disconnect water supply.
 - 5) Test and inspect joints for leaks.
 - 6) Option: Test ductile-iron piping according to AWWA C600, Section "Hydrostatic Testing." Use test pressure of at least 10 psig (69 kPa).
 - b. Sanitary Sewerage: Perform air test according to UNI-B-6.
 - 1) Option: Test concrete piping according to ASTM C 924 (ASTM C 924M).
 6. Manholes: Perform hydraulic test according to ASTM C 969 (ASTM C 969M).
 7. Leaks and loss in test pressure constitute defects that must be repaired.
 8. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 02530

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SECTION 02553 - NATURAL GAS DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following for natural gas distribution outside the building:
 - 1. Piping.
 - 2. Valves.
 - 3. Service regulators.
 - 4. Service meters.
 - 5. Concrete bases.
- B. Related Sections include the following:
 - 1. Division 15 Section "Fuel Gas Piping" for natural gas piping inside the building.

1.3 DEFINITIONS

- A. Gas Main: Existing natural gas piping.
- B. Gas Distribution: Piping from gas main to individual service-meter assemblies.
- C. Service-Meter Assembly: Piping, valves, service regulator, service meter, and specialties.
- D. Point of Delivery: Piping outlet from service-meter assembly.
- E. Natural Gas Piping: Piping that conveys natural gas from point of delivery to natural gas utilization devices inside the building.
- F. PE: Polyethylene plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Working-Pressure Ratings:
 - 1. Piping and Valves: 100 psig (690 kPa) minimum, unless otherwise indicated.
 - 2. Service Regulators: 100 psig (690 kPa) minimum, unless otherwise indicated.
 - 3. Service Meters: 5 psig (34.5 kPa) minimum, unless otherwise indicated.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. PE pipe and fittings.
 - 2. Valves.
 - 3. Service regulators. Indicate pressure ratings and capacities.
 - 4. Service meters. Indicate pressure ratings and capacities. Include meter bars.
- B. Shop Drawings: For natural gas service piping and service meter assembly. Include plans, elevations, sections, details, and attachments to other work.
- C. Welding certificates.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For the following natural gas distribution equipment and accessories to include in emergency, operation, and maintenance manuals.
 - 1. Service regulators.
 - 2. Service meters.
 - 3. Earthquake valves.

1.6 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of earthquake valves and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- C. Comply with requirements of utility supplying natural gas and with authorities having jurisdiction for natural gas systems.
- D. Comply with ANSI Z223.1 and NFPA 54 for materials, installation, testing, inspection, and purging.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle liquids to avoid spillage and ignition. Notify gas supplier. Do not leave flammable liquids on premises overnight.
- B. Store PE pipes and valves protected from direct sunlight.

1.8 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural Gas Service: Do not interrupt natural gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of gas supply according to requirements indicated:
 - 1. Notify Contracting Officer no fewer than ten days in advance of proposed interruption of natural gas service.
 - 2. Do not proceed with interruption of natural gas service without Contracting Officer's written permission.

1.9 COORDINATION

- A. Coordinate connection to gas main with utility.
- B. Coordinate natural gas distribution with other utility Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPES AND FITTINGS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.
- B. PE Pipe: ASTM D 2513, SDR 11.
 - 1. PE Fittings: ASTM D 2683, socket type or ASTM D 3261, butt type with dimensions matching ASTM D 2513, SDR 11, PE pipe.
- C. Transition Fittings: Manufactured pipe fitting with one PE pipe end for heat-fusion connection to PE pipe and with one ASTM A 53/A 53M, Schedule 40, steel pipe end for threaded connection to steel pipe.

- D. Service-Line Risers: Manufactured PE pipe fitting with PE pipe inlet for heat-fusion connection to underground PE pipe; PE pipe riser section with protective-coated, anodeless, steel casing and threaded outlet for threaded connection to aboveground steel piping.

2.3 JOINING MATERIALS

- A. Components, Tapes, Gaskets, and Bolts and Nuts: Suitable for natural gas and as recommended by piping manufacturer.

2.4 SHUTOFF VALVES

- A. Shutoff Valves, General: Manual operation, suitable for natural gas service, and with 100-psig (690-kPa) minimum working-pressure rating.
- B. Threaded Valves, NPS 1 (DN 25) and Smaller: Include listing by agency acceptable to authorities having jurisdiction.
- C. Nonlubricated, Tapered Plug Valves: Brass or cast-iron body, with brass tapered plug; lever operation; and complying with ASME B16.33, MSS SP-78, UL 842. Include lever.

- 1. Manufacturers:

- a. Essex Brass.
- b. Lyall, R. W. & Company, Inc.
- c. McDonald, A. Y. Mfg. Co.
- d. Mueller Company.

- D. Ball Valves: Bronze body, with chrome-plated brass ball; lever handle; and complying with ASME B16.33, MSS SP-110, UL 842.

- 1. Manufacturers:

- a. Conbraco Industries, Inc.
- b. Hammond Valve.
- c. Maxitrol Company.
- d. Milwaukee Valve Company.
- e. NIBCO.
- f. Stockham.
- g. Watts Industries, Inc.

- E. PE Valves: Made for gas distribution, with nut or flat head for key operation; and complying with ASME B16.40, UL 842.

- 1. Manufacturers:

- a. Kerotest Manufacturing Corp.
- b. Lyall, R. W. & Company, Inc.
- c. Nordstrom Valves, Inc.

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- d. Perfection Corporation; Gas Products Div.

2.5 EARTHQUAKE VALVES

- A. Description: ASCE 25 mechanical-operation and automatic-shutoff type with operating-pressure rating at least as great as system pressure.
 - 1. Pipe Connections:
 - a. NPS 2 (DN 50) and Smaller: Threaded.
 - b. NPS 2-1/2 (DN 65) and Larger: Flanged.
 - 2. Manufacturers:
 - a. Pacific Seismic Products, Inc.
 - b. Quake Defense, Inc.; Emergency Fail-Safe Systems.
 - c. Safe T Quake.
 - d. Seismic Safety Products, Inc.
 - e. US QuakeKoso Canada, Inc.

2.6 SERVICE REGULATORS

- A. Description: Natural gas service regulator complying with ANSI B109.4 or DIR 006.3-listed for service regulators.
 - 1. Construction: Single-stage, steel-jacketed, corrosion-resistant diaphragm type. Include atmospheric vent and elevation compensator.
 - 2. Pipe Connections:
 - a. NPS 2 (DN 50) and Smaller: Threaded.
 - b. NPS 2-1/2 (DN 65) and Larger: Flanged.
 - 3. Manufacturers:
 - a. American Meter Co.
 - b. Fisher Controls International.
 - c. Invensys Energy Metering.
 - d. National Meter.
 - e. Schlumberger Limited.

2.7 SERVICE METERS

- A. Rotary Service Meters: ANSI B109.3, rotating-lobe type, with registration in cubic feet (cubic meters).
 - 1. Manufacturers:
 - a. American Meter Co.

b. Schlumberger Limited.

B. Service-Meter Bars: Malleable- or cast-iron frame for supporting service meter. Include offset swivel pipes, nuts with O-ring seal, factory- or field-installed dielectric unions, and threaded ends.

1. Exception: Omit offset swivel pipes if dimensions match meter connections.
2. Manufacturers:

- a. Fisher Controls International.
- b. McDonald, A. Y. Mfg. Co.
- c. Mueller Company.
- d. National Meter.
- e. Schlumberger Limited.

2.8 CONCRETE BASES

A. Description: Precast concrete made of 3000-psi- (20.7-MPa-) minimum, 28-day compressive strength reinforced concrete; at least 4 inches (100 mm) thick and 4 inches (100 mm) larger in each dimension than supported item, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off gas to premises or piping section.
- B. Inspect natural gas piping according to fuel gas code to determine that natural gas utilization devices are turned off in piping section affected.
- C. Comply with fuel gas code requirements for prevention of accidental ignition.

3.3 PIPING APPLICATIONS

- A. Flanges, unions, and transition and special fittings with pressure ratings same as or higher than system pressure rating may be used, unless otherwise indicated.
- B. Aboveground Piping:
 1. NPS 2 (DN 50) and Smaller: Steel pipe, butt-welding-type fittings, and welded joints. Joints for connection to threaded service regulators, service meters, and valves may be threaded.
 2. NPS 2 (DN 50) and Smaller: Steel pipe, malleable-iron fittings, and threaded joints.

- C. Underground Piping: PE pipe, PE fittings, and heat-fusion joints.
- D. Protective Conduit for Underground Piping: Steel pipe and threaded- or welding-type fittings.
- E. Underground-to-Aboveground Piping Connections: Service-line riser.
- F. PE-to-Steel Piping Connections: Transition fitting.

3.4 VALVE APPLICATIONS

- A. Drawings indicate types of shutoff valves to be used. If specific types are not indicated, the following requirements apply:
 - 1. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping gas mains.
 - 2. Underground: Use PE valves.
 - 3. Aboveground, NPS 2 (DN 50) and Smaller: Nonlubricated tapered plug valves.
 - 4. Aboveground, NPS 2 (DN 50) and Smaller: Ball valves.
 - 5. Aboveground, NPS 2-1/2 (DN 65) and Larger: Nonlubricated plug valves.

3.5 PIPING INSTALLATION

- A. Install underground, natural gas distribution piping buried at least 36 inches (900 mm) below finished grade.
- B. Install underground, PE, natural gas distribution piping according to ASTM D 2774.
- C. Install underground, PE, natural gas distribution piping at entrance to and under part of building in steel piping protective conduit that is vented to outside.
- D. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate would be subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- E. Terminate service-regulator horizontal vents or horizontal vent piping with reducing-elbow fittings with large end as outlet. Install fitting outlet turned down with corrosion-resistant insect screen in outlet.

3.6 SERVICE-METER ASSEMBLY INSTALLATION

- A. Install service-meter assemblies aboveground.

- B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.
- C. Install service regulators with vent outlet horizontal or facing down. Install screen in outlet if not integral with service regulator.
- D. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.
- E. Install service meters downstream from pressure regulators.
- F. Install pressure-relief or pressure-limiting devices so they can be readily operated to determine if devices are free of debris, tested to determine pressure at which they will operate, and examined for leakage if closed.
- G. Install at least two pipe bollards in front of meter assemblies.

3.7 VALVE INSTALLATION

- A. Install PE shutoff valves on branch connections to existing underground, natural gas distribution piping. Install valves with valve boxes.
- B. Install metal shutoff valves on aboveground, natural gas distribution piping.
- C. Install earthquake valves aboveground, outside building, and according to listing applications.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect gas distribution piping to natural gas source and extend to service-meter assemblies and points indicated. Connect to building's natural gas piping if it is installed; otherwise, terminate piping with caps, plugs, or flanges, as required for piping material. Refer to Division 15 Section "Fuel Gas Piping" for natural gas piping inside the building.
- C. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.
- D. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
- E. Connect to utility gas main according to utility's procedures and requirements.
- F. Install aboveground, natural gas distribution piping upstream from equipment shutoff valves, electrically continuous, and bonded to grounding electrode according to NFPA 70.
- G. Do not use natural gas distribution piping as grounding electrode.

3.9 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on or near each service regulator, service meter, and earthquake valve.
 - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- B. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tape over natural gas distribution piping during backfilling of trenches for piping.
- C. Refer to Division 2 Section "Earthwork" for warning tapes.

3.10 PAINTING

- A. Paint exposed metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties except units with factory-applied paint or protective coating.
- B. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas distribution according to requirements of fuel gas code and utility.
- B. Repair leaks and defective valves and specialties and retest system until no leaks exist.
- C. Report results in writing.
- D. Verify correct pressure settings for service regulators.

3.12 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

END OF SECTION 02553

SECTION 02630 - STORM DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes storm drainage outside the building.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for soil material, excavating, backfilling and site grading for foundation drains connecting to storm drainage.

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

1.5 SUBMITTALS

- A. Shop Drawings: Include plans, elevations, details, and attachments for the following:
 - 1. Precast concrete manholes and other structures, including frames, covers, and grates.
- B. Coordination Drawings: Show manholes and other structures, pipe sizes, locations, and elevations. Include details of underground structures and connections. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between piping and proximate structures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic structures, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

- B. Locate existing structures and piping to be closed and abandoned.
- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Contracting Officer not less than two days in advance of proposed utility interruptions.

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:

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 PIPES AND FITTINGS

- A. PVC Sewer Pipe and Fittings: According to the following:
 - 1. PVC Sewer Pipe and Fittings, NPS 15 (DN375) and Smaller: ASTM D 3034, SDR 35, for solvent-cemented or gasketed joints.
 - a. Gaskets: ASTM F 477, elastomeric seals.
- B. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M), Class III, Wall B, for gasketed joints.
 - 1. Gaskets: ASTM C 443 (ASTM C 443M), rubber.

2.4 MANHOLES

- 1. Precast Concrete Manholes shall conform with CTDOT Standard Specifications, latest edition, Section 5.07.
- B. Manhole Frames and Covers shall conform with CTDOT Standard Specifications, latest edition, Section 5.07.

2.5 CATCH BASINS

- 1. Precast Concrete Catch Basins shall conform with CTDOT Standard Specifications, latest edition, Section 5.07.
- B. Frames and Grates: ASTM A 536, Grade 60, ductile iron designed for heavy-duty service. Include flat grate with small square or short-slotted drainage openings.
 - 1. Size: 24 by 24 inches (610 by 610 mm) minimum, unless otherwise indicated.
 - 2. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

2.6 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 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 (27.6 MPa) minimum, with 0.45 maximum water-cementitious ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed steel.

- C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cementitious ratio.
 - 1. Include channels and benches in manholes.
 - a. 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.
 - 1) Invert Slope: 1 percent through manhole.
 - 2) Invert Slope: 2 percent through manhole.
 - 3) Invert Slope: None.
 - b. Benches: Concrete, sloped to drain into channel.
 - 1) Slope: 8 percent.
 - 2) Slope: 4 percent.
 - 2. Include channels in catch basins.
 - a. 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.
 - 1) Invert Slope: 1 percent through catch basin.
 - 2) Invert Slope: 2 percent through catch basin.
 - 3) Invert Slope: None.

- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water-cementitious ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 IDENTIFICATION

- A. Materials and their installation are specified in Division 2 Section "Earthwork." Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.
 - 1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 PIPING APPLICATIONS

- A. General: Include watertight, silt-tight, or soil-tight joints, unless watertight or silt-tight joints are indicated.
- B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.
- C. Gravity-Flow Piping: Use the following:
 - 1. NPS 6 to NPS 15 (DN150 to DN375): PVC sewer pipe and fittings, or gaskets and gasketed joints.
 - 2. NPS 18 to NPS 36 (DN450 to DN900): Reinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.

3.4 INSTALLATION, GENERAL

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.
- 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 use of lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.
- C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- D. Use 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. Install gravity-flow piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
 - 2. Install piping with 36-inch (1000-mm) minimum cover.

- F. Extend storm drainage piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.

3.5 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. General: Join and install pipe and fittings according to installations indicated.
- B. PVC Sewer Pipe and Fittings: As follows:
 - 1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
 - 2. Install according to ASTM D 2321.
- C. Concrete Pipe and Fittings: Install according to ACPA's "Concrete Pipe Installation Manual." Use the following seals:
 - 1. Round Pipe and Fittings: ASTM C 443 (ASTM C 443M), rubber gaskets.
- D. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.
- E. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

3.6 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Form continuous concrete channels and benches between inlets and outlet.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere, unless otherwise indicated.
- D. Install precast concrete manhole sections with gaskets according to ASTM C 891.

3.7 CATCH-BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.8 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.9 DRAINAGE SYSTEM INSTALLATION

- A. Assemble and install components according to manufacturer's written instructions.
- B. Assemble and install stainless-steel drainage systems according to ASME A112.3.1 and manufacturer's written instructions.

- C. Install with top surfaces of components, except piping, flush with finished surface.
- D. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.
- E. Embed channel sections and drainage specialties in 4-inch (100-mm) minimum concrete around bottom and sides.
- F. Fasten grates to channel sections if indicated.
- G. Assemble trench sections with flanged joints.
- H. Embed trench sections and drainage specialties in 4-inch (100-mm) minimum concrete around bottom and sides.
- I. Make piping connections and install stainless-steel piping with gasketed joints between system components.

3.10 FIELD QUALITY CONTROL

- A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
 - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
 - 2. Place plug in end of incomplete piping at end of day and when work stops.
 - 3. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) 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. 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.
- C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

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4. Submit separate reports for each test.
5. Where authorities having jurisdiction do not have published procedures, perform tests as follows:
 - a. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
6. Leaks and loss in test pressure constitute defects that must be repaired.
7. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 02630

SECTION 02741 - HOT-MIX ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hot-mix asphalt paving.
 - 2. Pavement-marking paint.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 DEFINITIONS

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.
- B. Connecticut DOT: Department of Transportation.

1.4 SYSTEM DESCRIPTION

- A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of standard specifications of the State of Connecticut Department of Transportation.
 - 1. Standard Specification: Standard Specifications for Roads, Bridges and Incidental Construction, latest edition, including revisions and amendments.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
- B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
- C. Job-Mix Designs: For each job mix proposed for the Work.
- D. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international graphics symbol, spaces dedicated to people with disabilities.
- E. Samples: For each paving fabric, 12 by 12 inches (300 by 300 mm) minimum.

- F. Qualification Data: For manufacturer.
- G. Material Test Reports: For each paving material.
- H. Material Certificates: For each paving material, signed by manufacturers.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer.
 - 1. Manufacturer shall be a paving-mix manufacturer registered with and approved by State of Connecticut Department of Transportation.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.
- C. Regulatory Requirements: Comply with State of Connecticut Specifications for Roads, Bridges and Incidental Construction.
- D. Asphalt-Paving Publication: Comply with AIMS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.
- E. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
 - 1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - 2. Review condition of subgrade and preparatory work.
 - 3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
 - 4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
 - 1. Prime and Tack Coats: Minimum surface temperature of 60 deg F (15.5 deg C).
 - 2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
 - 3. Asphalt Base Course: Minimum surface temperature of 40 deg F (4 deg C) and rising at time of placement.

4. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.5 deg C) at time of placement.
- 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 (4 deg C) for oil-based materials, 50 deg F (10 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. Provide aggregate materials accordance with State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction, Section M.05.

2.2 ASPHALT MATERIALS

- A. Use bituminous materials in accordance with State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction, Section M.04.

2.3 AUXILIARY MATERIALS

- A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time of less than 3 minutes.
 1. Color: As indicated.

2.4 MIXES

- A. Provide job-mixes in accordance with CTDOT Standard Specifications Section M.04.03 Class 1 for binder course and Class 2 for top course.

2.5 PRECAST CONCRETE CURB

- A. Provide precast concrete curb materials in accordance with State of Connecticut Standard Specifications for Roads, Bridges and Incidental Construction, Section 8.21.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.3 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
 - 1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- B. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m). Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure for 72 hours minimum.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.
- C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
 - 2. Place hot-mix asphalt surface course in single lift.
 - 3. Spread mix at minimum temperature of 250 deg F (121 deg C).

4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
 3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
 4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.6 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
1. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent nor greater than 100 percent.
 2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/2 inch (13 mm).
 - 2. Surface Course: Plus 1/4 inch (6 mm), no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch (6 mm).
 - 2. Surface Course: 1/8 inch (3 mm).
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

3.8 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Contracting Officer.
- B. Allow paving to age for 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).
 - 1. Broadcast glass spheres uniformly into wet pavement markings at a rate of 6 lb/gal. (0.72 kg/L).

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than 3 cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.10 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 02741

SECTION 02751 - CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
 - 1. Taxiways and aprons.
 - 2. Equipment pads.
 - 3. Walkways.
 - 4. Doorway pads, steps and aprons.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for subgrade preparation, grading, and subbase course.
 - 2. Division 2 Section "Concrete Pavement Joint Sealants" for joint sealants within concrete pavement and at isolation joints of concrete pavement with adjacent construction.
 - 3. Division 3 Section "Cast-in-Place Concrete" for general building applications of concrete.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete pavement mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
- D. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials and aggregates.
2. Steel reinforcement and reinforcement accessories.
3. Epoxy grouts.
4. Admixtures.
5. Curing compounds.
6. Joint fillers.

E. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
1. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.
- E. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.
- G. Mockups: Cast mockup of 5-foot by 10-foot section of concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 3. Obtain Architect's approval of mockups before starting construction.
 4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
 5. Demolish and remove approved mockups from the site when directed by Architect.
 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
 - 1. Before submitting design mixes, review concrete pavement mix design and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with concrete pavement to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixes.
 - c. Ready-mix concrete producer.
 - d. Concrete subcontractor.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Comply with all "Dig Safe" requirements.

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, smooth exposed surfaces.
 - 1. Use flexible or curved forms for curves of a radius 100 feet (30.5 m) or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Deformed-Steel Welded Wire Fabric: ASTM A 497, flat sheet.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

D. Dowels

Dowels shall be single piece, plain (non-deformed) steel bars conforming to ASTM A 615/A 615M Grade 60 or higher. Dowels shall be free of loose, flaky rust and loose scale and shall be clean and straight.

E. Tie Bars

Tie bars shall be deformed steel bars conforming to ASTM A 615/A 615M Grade 60 or higher.

2.3 EPOXY RESIN

A. All epoxy-resin materials shall be two-component materials conforming to ASTM C 881, Class as appropriate for each application temperature to be encountered; except that, in addition, the materials shall meet the following requirements:

1. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.

2.4 CONCRETE MATERIALS

A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.

B. Portland Cement: ASTM C 150, Type I or II.

1. Fly Ash: ASTM C 618, Class F or C.

C. Aggregate: ASTM C 33, uniformly graded, from a single source, with coarse aggregate as follows:

1. Maximum Aggregate Size: 3/4 inch (19 mm) nominal.

2. Do not use fine or coarse aggregates containing substances that cause spalling.

D. Water: ASTM C 94.

2.5 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.

B. Air-Entraining Admixture: ASTM C 260.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

E. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.6 CURING MATERIALS

- A. Refer to Division 3 "Cast-in-Place Concrete" for curing materials.

2.7 RELATED MATERIALS

- A. Pavement-Marking Paint: Latex, water-base emulsion; ready mixed; complying with FS TT-P-1952.

- 1. Color: As approved, to match existing pavement markings to be replaced.

2.8 CONCRETE MIXES

- A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.

- 1. Do not use Owner's field quality-control testing agency as the independent testing agency.

- C. Proportion mixes to provide concrete with the following properties:

- 1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 3. Slump Limit: 3 inches (75 mm).

- a. Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 8 inches (200 mm) after adding admixture to plant- or site-verified, 2- to 3-inch (50- to 75-mm) slump.

- D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.

- E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus or minus 1.5 percent:

- 1. Air Content: 6.0 percent for 3/4-inch (19-mm) maximum aggregate.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.
- B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 PLACING DOWELS AND TIE BARS

- A. Dowels shall be installed with alignment not greater than 1 mm per 100 mm, 1/8 inch per ft. Except as otherwise specified below, location of dowels shall be within a horizontal tolerance of plus or minus 15 mm (5/8 inch) and a vertical tolerance of plus or minus 5 mm (3/16 inch).
- B. The portion of each dowel intended to move within the concrete or expansion cap shall be painted with one coat of rust-inhibiting primer paint, and then oiled just prior to placement.
- C. Dowels and tie bars in joints shall be omitted when the center of the dowel or tie bar is located within a horizontal distance from an intersecting joint equal to or less than one-fourth of the slab thickness.

3.5 DOWELS INSTALLED IN HARDENED CONCRETE

- A. Installation shall be by bonding the dowels into holes drilled into the hardened concrete. Holes approximately 3 mm (1/8 inch) greater in diameter than the dowels shall be drilled into the hardened concrete.
- B. Dowels shall be bonded in the drilled holes using epoxy resin injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel shall not be permitted.
- C. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic collar fitted around the dowel.
- D. The vertical alignment of the dowels shall be checked by placing the straightedge on the surface of the pavement over the top of the dowel and measuring the vertical distance between the straightedge and the beginning and ending point of the exposed part of the dowel.

3.6 JOINTS IN WALKS, PADS AND OTHER NON-AIRCRAFT PAVEMENT

- A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
 - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
 - 2. Coordinate scoring pattern of entry areas and amphitheater with Architect.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.
 - 1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 - 2. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 24 feet (7.3 m), unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler less than 1/2 inch (12 mm) or more than 1 inch (25 mm) 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. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- 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:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
 - a. Radius: 1/4 inch (6 mm).
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
1. Radius: 1/4 inch (6 mm).

3.7 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces. Do not use sodium chloride, calcium chloride or other chloride compounds to prevent freezing of subbase.
- C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery, at Project site, or during placement.

- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry-shake surface treatments.
- I. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- J. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.8 CONCRETE FINISHING FOR NON-AIRCRAFT PAVEMENT

- A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-

driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, for equipment pads only.
2. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

3.9 FINISHING OF AIRCRAFT PAVEMENT

- A. Clary screeds, "bridge deck" finishers, or other rotating pipe or tube-type equipment shall not be permitted.
- B. The sequence of machine operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, texturing, and then edging of joints.
- C. Hand finishing shall be used only infrequently and only on isolated areas of odd slab shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Equipment to be used for supplemental hand finishing shall primarily be 3 to 4 m (10 to 12) feet cutting straightedges; only very sparing use of bull floats shall be allowed.
- D. At no time shall water be added to the surface of the slab in any way, except for fog (mist) sprays to prevent plastic shrinkage cracking.
- E. While the concrete is still plastic, irregularities and marks in the pavement surface shall be eliminated by means of cutting straightedges, 3 to 4 m (10 to 12) feet in length. Depressions shall be filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished.
- F. Long-handled, flat "full floats" shall be used sparingly and only as necessary to correct minor, scattered surface defects.
- G. Hand finishing operations shall be used only for those unusual slabs as specified previously.
- H. Grate tampers (jitterbugs) shall not be used.
- I. As soon as placed and vibrated, the concrete shall be struck off and screeded. The surface shall be tamped with a strike-off and tamping screed, or vibratory screed. Immediately following the final tamping of the surface, the pavement shall be floated longitudinally.
- J. Long-handled, flat full floats shall be used sparingly and only as necessary to correct surface defects. Finishing with hand floats and trowels shall be held to the absolute minimum necessary.

- K. Joints and edges shall not be overfinished. No water shall be added to the pavement during finishing operations.

3.10 TEXTURING OF AIRCRAFT PAVEMENT

- A. Before the surface sheen has disappeared and before the concrete hardens, the surface of the pavement shall be given a texture as described herein.
- B. Following initial texturing on the first day of placement, the Placing Foreman, Contracting Officer representative, and a representative of the Using Agency shall inspect the texturing for compliance with design requirements.
- C. Replacement pavement shall be textured to match, as closely as practicable, texture of existing adjacent slabs to remain. Texturing shall be by one of the following methods, as selected by the Contractor and approved by the Contracting Officer.
 - D. Fabric-Drag Surface Finish
 - 1. Surface texture shall be applied by dragging the surface of the pavement, in the direction of the concrete placement, with a moist fabric drag. The dragging shall produce a uniform finished surface having a fine sandy texture without disfiguring marks.
 - E. Broom Texturing
 - 1. Surface texture shall be applied using a mechanical stiff bristle broom drag of a type that will uniformly score the surface transverse to the pavement center line.
 - 2. The broom shall be capable of traversing the full width of the pavement in a single pass at a uniform speed and with a uniform pressure. Successive passes of the broom shall be overlapped the minimum necessary to obtain a uniformly textured surface.
 - 3. The scores should be uniform in appearance and approximately 1.5 mm (1/16 inch) in depth, but not more than 3 mm (1/8 inch) in depth. Hand brooming will be permitted only on isolated odd-shaped slabs or slabs where hand finishing is permitted.
 - F. Wire-Comb Texturing
 - 1. Surface texture transverse to the pavement center line shall be applied using a mechanical wire comb drag.
 - 2. The comb shall be capable of traversing the full width of the pavement in a single pass at a uniform speed and with a uniform pressure. Successive passes of the comb shall be overlapped the minimum necessary to obtain a continuous and uniformly textured surface.
 - 3. The scores shall be 2 to 5 mm (1/16 to 3/16) inch deep, 1.5 to 3 mm (1/16 to 1/8 inch) wide, and spaced 10 mm (3/8 inch) apart.

G. Surface Grooving

1. The pavement shall be grooved with a spring tine drag producing individual grooves 6 mm (¼ inch) deep and 6 mm (¼ inch) wide at a spacing between groove centerlines of 50 mm (2 inches).
2. These grooves shall be cut perpendicular to the centerline.
3. Before grooving begins, the concrete shall be allowed to stiffen sufficiently to prevent dislodging of aggregate.
4. Grooves shall not be cut within 150 mm (6 inches) of a transverse joint or crack.

- H. After texturing has been completed, the edge of the slabs along the forms shall be carefully finished with an edging tool to form a smooth rounded surface of 3 mm (1/8 inch) radius. No water shall be added to the surface during edging.

3.11 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot-weather protection during curing.
- B. Use only approved curing methods and only methods that will not mar, discolor or disturb concrete finish.
- C. Concrete for aircraft pavement shall be continuously protected against loss of moisture and rapid temperature changes for at least 7 days from the completion of finishing operations. Unhardened concrete shall be protected from rain and flowing water.
- D. Plastic shrinkage cracks that occur shall be filled by injection of approved epoxy resin after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry. Curing shall be accomplished by one of the following methods.
- E. A uniform coating of white-pigmented membrane-forming curing compound shall be applied to the entire exposed surface of the concrete including pavement edges as soon as the free water has disappeared from the surface after finishing.
- F. If evaporation is high and no moisture is present on the surface even though bleeding has not stopped, fog sprays shall be used to keep the surface moist until setting of the cement occurs. Curing compound shall then be immediately applied.
- G. Curing compound shall be applied to the finished surfaces by means of a self-propelled automatic spraying machine, equipped with multiple spraying nozzles with wind shields, spanning the newly paved lane.
- H. The curing compound shall be applied at a maximum application rate of 5 square meters per L. (200 square feet per gallon). The application of curing compound by hand-operated,

mechanical powered pressure sprayers will be permitted only on odd widths or shapes of slabs where indicated and on concrete surfaces exposed by the removal of forms.

- I. The compound shall form a uniform, continuous, cohesive film that will not check, crack, or peel and that will be free from pinholes and other discontinuities.
- J. Areas where the curing compound develops the above defects or is damaged by heavy rainfall, sawing or other construction operations within the curing period, shall be immediately resprayed.

3.12 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:

- 1. Elevation: 1/4 inch (6 mm).
- 2. Thickness: Plus 3/8 inch (9 mm), minus 1/4 inch (6 mm).
- 3. Surface: Gap below 10-foot- (3-m-) long, unlevelled straightedge not to exceed 1/4 inch (6 mm).
- 4. Lateral Alignment and Spacing of Bars and Dowels: 1 inch (25 mm).
- 5. Vertical Alignment of Bars and Welded Wire Fabric: 1/4 inch (6 mm).
- 6. Joint Spacing: 2 inches (50 mm).
- 7. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
- 8. Joint Width: Plus 1/8 inch (3 mm), no minus.
- 9. Sidewalk Cross Slope: 1.6% minimum (unless longitudinal slope exceeds 2%); and 2% maximum.

3.13 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with the Contracting Officer.
- B. Allow concrete pavement to cure for 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 pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).
 - 1. Broadcast glass spheres uniformly into wet pavement markings at a rate of 6 lb/gal. (0.72 kg/L).

3.14 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article.

- B. Testing Services: Testing shall be performed in accordance with the requirements of Division 3 Section "Cast-in-Place Concrete."
- C. Test results shall be reported in writing to Contracting Officer, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Contracting Officer. When cylinder test results indicate potential weaknesses or when weather or curing conditions indicate potential variations in field and cylinder conditions, but will not be used as the sole basis for approval or rejection.
- E. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Contracting Officer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.15 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.
- B. Drill test cores where directed by Contracting Officer when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 02751

SECTION 02765 – CONCRETE PAVEMENT JOINT SEALANTS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish all materials, labor, tools and equipment to seal expansion joints.

1.2 QUALITY ASSURANCE

- A. Manufacturing qualifications: The manufacturer of the specified product shall have in existence, for a minimum of 10 years, a program of training, certifying, and technically supporting a nationally organized Approved Contractor Program. The manufacturer shall also be certified as meeting the ISO 9000 Quality Standard at all facilities producing the specified product.
- B. Provide a notarized certificate stating that the joint filler meets the specified requirements and have the manufacturer's current printed literature on the specified product.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver the specified product in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers.
- B. Store and condition the specified product as recommended by the manufacturer.

1.4 JOB CONDITIONS

- A. Environmental Conditions: Do not apply material if it is raining or snowing, or if they appear to be imminent.
- B. Protection: Precautions should be taken to avoid damage to any surface near the work zone due to mixing and handling of the specified joint filler.

PART 2 - PRODUCTS

2.1 EXPANSION JOINT FILLED

- A. ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
- B. Filler must be compatible with backer rod and joint sealant material.

2.2 POLYURETHANE SEALANT

- A. The joint sealant shall be a two-component, non-sag or self-leveling, jet-fuel resistant, polyurethane-base material. It shall be applicable in horizontal, vertical, and overhead joints. The sealant shall be principally a chemical cure to form an elastomeric substance. The color shall be introduced through a color-pak system.
- B. Any primers, as required, recommended by the manufacturer of the specified product, approved by the Engineer.
- C. Sand filler/bond breaker shall conform to the requirements of State of Connecticut DOT Standard Specifications for roads and bridges Section M.05.02-2 sand cover.

2.3 BACKER ROD

- A. The backer rod material shall be an expanded closed cell polyethylene form capable of withstanding the temperature of the hot binder material, shall have a diameter 150 percent the width of the joint opening and shall have the following properties:

Density	2.0 lbs./cu.ft. min.	ASTM D 1622
Tensile Strength	25 psi min.	ASTM D 1623
Water Absorption	1 percent of weight max.	ASTM C 509

- B. Backer rod must be compatible with joint filler and joint sealant.

PART 3 – EXECUTION

3.1 SURFACE PREPARATION

- A. The joint and adjacent substrate must be clean, sound, dry and free of frost. Remove all traces of the old sealant, dust, grease, curing compounds, waxes, impregnations, foreign particles, efflorescence and other bond inhibiting materials from the surface by mechanical means, i.e. – sandblasting, etc., as approved by the Engineer. Blow joint free of dust using compressed air line equipped with an oil trap.
 - 1. Polyurethane sealant – Install sand fill bond breaker to prevent 3-sided adhesion, control sealant depth and provide a tooling base. Reference: ACI 504R-77 “Guide to Joint Sealants for Concrete Structures”; Sealant Waterproofing Restoration Institute, Applicator Training Manual “Applying Sealants.”

3.2 POLYURETHANE JOINT SEALANT APPLICATION

- A. Mixing of the polyurethane sealant: Pour out entire contents of Component B into pail of Component A. Now add entire contents of color-pak into pail and mix with low-speed drill (400-

600 rpm) and approved paddle. Mix for 5-7 minutes to achieve a uniform color and consistency. Avoid entrapment of air during mixing.

B. Joints

1. Placement Procedure: Prime all substrates only as required based upon the recommendations of the manufacturer of the specified product, when field testing indicates need, and when the joints will be subject to immersion after cure, as approved by the Engineer.
2. Install approved sand fill bond breaker in all joints to prevent three-sided bonding and to set the depth of the sealant. Approval of the bond breaker shall be made by the Engineer.
3. Joints shall be masked to prevent discoloration or application on unwanted areas, as directed by the Engineer. If masking tape is used, it shall not be removed before tooling, yet must be removed before the initial cure of the sealant. Do not apply the masking tape until just prior to the sealant application.
4. Install sealant into the prepared joints when the joint is at mid-point of its designed expansion and contraction (approximately 50 degrees).
 - a. Non-sag sealant: Load the sealant into a caulking gun. Place the nozzle of the gun, either hand or air or electric powered, into the bottom of the joint and fill entire joint. Keep the tip of the nozzle in the sealant, continue on with a steady flow of sealant proceeding the nozzle to avoid air entrapment. Avoid overlapping the sealant to eliminate the entrapment of air. Tool, as required, to properly fill the joint.
 - b. Self-leveling sealant: Pour or extrude the sealant into the prepared joint in one direction and allow it to flow and level as necessary. Avoid overlapping the sealant to eliminate the entrapment of air. Tool, as required, to properly fill the joint.
5. Adhere to all limitation and cautions for the polyurethane sealant as stated in the manufacturers printed literature.

3.3 CLEANING

- A. The uncured polyurethane sealant can be cleaned from tools with an approved solvent. The cured polyurethane sealant can only be removed mechanically.
- B. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

END OF SECTION 02765

SECTION 02920 - LAWNS AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes seeding and mulching.

1.2 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product certificates.
- C. Planting Schedule: Indicating anticipated planting dates.

1.4 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.
- B. Retain below for imported topsoil or topsoil to be reused.
- C. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.
- B. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

1.6 LAWN MAINTENANCE

- A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 - 1. Seeded Lawns: 60 days from date of Substantial Completion.
- B. Mow lawn as soon as top growth is tall enough to cut. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings.

PART 2 - PRODUCTS

2.1 SEED

- A. Seed Species: State-certified seed of grass species, as follows:
 - 1. Provide certified grass-seed blends or mixes, proportioned by weight as follows:

Proportion	Name	Min. Pct. Germ.	Min. Pct. Pure Sd.	Max. Pct. Weed Sd.
30 percent	Creeping Red Fescue (Festuca rubra variety)	85	98	0.50
30 percent	Chewings red fescue (Festuca rubra variety)	85	98	0.50
15 percent	Kentucky Bluegrass (Poa pratensis)	80	85	1.00
25 percent	Perennial rye grass (Lolium perenne)	90	98	0.50

2.2 PLANTING MATERIALS

- A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 5 percent organic material content and maximum of 6; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth.
 - 1. Topsoil Source: Reuse surface soil stockpiled on-site and supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Verify suitability of stockpiled surface soil to produce topsoil.
- B. Inorganic Soil Amendments:
 - 1. Lime: ASTM C 602, Class T or O, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.
 - 2. Select appropriate sulfate compounds from subparagraphs below. Sulfur is used to lower pH and neutralize alkaline soils. Revise descriptions and add proprietary products if required.

3. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through No. 6 (3.35-mm) sieve and a maximum 10 percent passing through No. 40 (0.425-mm) sieve.
4. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
5. Aluminum Sulfate: Commercial grade, unadulterated.

C. Organic Soil Amendments

1. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8.
2. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with pH range of 3.4 to 4.8.
3. Retain subparagraph above or first subparagraph below, if applicable. Retain above if sphagnum peat moss, an acidic peat, is required. Retain below if peat types with neutral pH are required.
4. Peat: Finely divided or granular texture, with pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having water-absorbing capacity of 1100 to 2000 percent.
5. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture, free of chips, stones, sticks, soil, or toxic materials.

D. Fertilizer:

1. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.
2. Superphosphate is an inorganic, neutral source of phosphorus useful in alkaline calcareous soils of arid areas.
3. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
4. 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:
 - a. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
5. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - a. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

E. Mulches:

1. Hay Mulch: Provide air-dry, clean, mildew- and seed-free, acceptable native or forage grass, with less than 20% moisture content by weight.

2.3 PLANTING SOIL MIX

- A. Planting Soil Mix: Mix topsoil with soil amendments and fertilizers in the quantities as recommended by the topsoil analysis for the type of crop being grown.

PART 3 - EXECUTION

3.1 LAWN PREPARATION

- A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Government's property.
 - 1. Spread topsoil to a minimum depth of 4 inches (100 mm) but not less than required to meet finish grades after rolling and natural settlement. Do not spread topsoil if topsoil or subgrade is frozen, muddy, or excessively wet..
 - 2. Apply soil amendments and fertilizers according to topsoil analysis recommendations.
- B. Unchanged Subgrades: If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare surface soil as follows:
 - 1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
 - 2. Loosen surface soil to a depth of at least of 6 inches (150 mm). Apply soil amendments and fertilizers according to topsoil analysis recommendations. Till soil to a homogeneous mixture of fine texture.
 - 3. Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, trash, and other extraneous matter.
 - 4. Legally dispose of waste material, including grass, vegetation, and turf, off Government's property.
- C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.
- D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- E. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

3.2 SEEDING

- A. Sowing rates vary with grass species and mixtures. Revise first paragraph below to suit Project.
- B. Sow seed at the rate specified for each seed mixture.
- C. Rake seed lightly into top 1/8 inch (3 mm) of topsoil, roll lightly, and water with fine spray.
- D. Retain paragraph below if straw protection is required for seeded areas.
- E. Protect seeded areas with slopes exceeding 1:4 by spreading hay mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.
- F. Below is usually required in warm, dry climates.

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- G. Protect seeded areas from hot, dry weather or drying winds by applying potable water. Saturate soil with fine waterspray as required.

3.3 SATISFACTORY LAWNS

- A. Satisfactory Seeded Lawn: 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. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).
- B. Reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

END OF SECTION 02920

SECTION 03300 - CAST-IN-PLACE CONCRETE

1.1 GENERAL

- A. Submittals: In addition to Product Data, submit design mixes and the following for each concrete mix:
 - 1. Shop Drawings detailing fabrication, bending, and placement.
 - 2. Material certificates signed by product manufacturers certifying that product complies with requirements.
- B. Quality Assurance: Comply with ACI 301, "Specification for Structural Concrete," and ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 1. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
 - 2. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1.2 APPLICABLE PUBLICATIONS

- A. State of Connecticut Department of Transportation (CTDOT), Standard Specifications for Roads and Bridges.

1.3 PRODUCTS

- A. Steel Reinforcement: As follows:
 - 1. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Concrete Materials: As follows:
 - 1. Portland Cement: ASTM C 150, Type I or II.
 - 2. Aggregate: ASTM C 33, uniformly graded, from a single source.
 - 3. Water: ASTM C 94.
 - 4. Air-Entraining Admixture: ASTM C 260.
- C. Related Materials: As follows:
 - 1. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, of type, class, and grade to suit requirements.
- D. Curing Materials: As follows:

1. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 2. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.
 3. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- E. Concrete Mixes: Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, with the following properties:
1. Compressive Strength (28 Days): 4000 psi conforming to Section M.03 of the CTDOT Standard Specifications for Class A Concrete.
 2. Slump: 4 inches.
 3. Air Content: 4.5 to 7.0 percent.
- F. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to Section M.03 of the CTDOT Standard Specifications, and furnish batch ticket information.

1.4 EXECUTION

- A. Design, construct, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- C. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved 28-day design compressive strength.
- D. Comply with ACI 318, ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.
- E. Steel Reinforcement: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- F. Concrete Placement: Deposit concrete continuously and avoid segregation. Deposit concrete in forms in horizontal layers no deeper than 24 inches, avoiding cold joints.
1. Consolidate concrete with mechanical vibrating equipment.
 2. Screed and initial-float concrete floors and slabs using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
 3. Comply with ACI 306.1 for cold-weather concrete placement.

4. Place concrete according to recommendations in ACI 305R when hot-weather conditions exist.
- G. Finish formed surfaces as follows:
1. Apply rough-formed finish, defined in ACI 301, to concrete surfaces indicated or not exposed to public view.
- H. Concrete Protection and Curing: Protect concrete from excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
1. Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause excessive moisture loss.
 2. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
 3. Cure formed and unformed concrete for at least seven days by moisture curing, moisture-retaining-cover curing.
- I. Testing Agency: Engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Tests shall be performed according to ACI 301.
- J. Defective Concrete: Repair and patch defective areas when approved by Contracting Officer. Remove and replace concrete that cannot be repaired and patched to Owner's approval.

END OF SECTION 03300

SECTION 03395 – CURING, SEALING AND HARDENING CONCRETE FLOORS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Single application cure-seal-hardener for new concrete floors.
- B. Precautions for avoiding staining concrete before and after application.

1.3 RELATED SECTIONS

- A. Section 03300 – Cast-In-Place Concrete: Concrete slabs.

1.4 SUBMITTALS

- A. Submit under provisions of Division 1 Section, Submittal Procedures.
- B. Material requirements for concrete to which cure-seal-hardener is to be applied, including cement type, water-cement ratio, type of trowel finish, limitations on admixtures, pigments, bonding agents, and bond breakers, etc.
- C. Product Data: Manufacturer's data sheets, including product specifications, test data, preparation instructions and recommendations, storage and handling requirements and recommendations, and installation methods.
- D. Maintenance instructions, including precautions for avoiding staining after application.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Applicator experienced with installation of product and certified by manufacturer, or applicator experienced with similar products and providing manufacturer's field technician of site to advise on application procedures; and providing adequate number of skilled workers trained and familiar with application requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver product in factory numbered and sealed drums, with numbers recorded for Owner's records.
- B. Store products in manufacturer's unopened drums until ready for installation.

1.7 PROJECT CONDITIONS

- A. No satisfactory procedures are available to remove petroleum or rust stains from concrete. Prevention is therefore essential. Take precautions to prevent staining of concrete prior to application of cure-seal-hardener and for minimum of three months after application.
 - 1. Prohibit parking of vehicles on concrete slab.
 - 2. If construction equipment must be used for application, diaper all components that might drip oil, hydraulic fluid or other liquids.
 - 3. Prohibit pipe cutting using pipe cutting machinery on concrete slab.
 - 4. Prohibit temporary placement and storage of steel members on concrete slab.
- B. Do not install products under environmental conditions outside manufacturer's absolute limits.
- C. Do not use frozen material; thaw and agitate prior to use.

1.8 WARRANTY

- A. Provide manufacturer's warranty that a structurally sound concrete surface prepared and treated according to the manufacturer's directions will remain permanently dustproof, hardened and water repellent. If after the specified sealing period the treated surface does not remain dustproof, hardened and water repellent, provide, at manufacturer's expense, sufficient material to reseal defective areas.

PART 2 – PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Ashford Formula, Curecrete Distribution, Inc; 1203 West Spring Creek Place, Springville, UT 84663. ASD Tel: (800) 9988-5664. Fax: (801) 489-3307. Email: www.ashfordformula.com.
- B. Kure & Harden, Sonneborn, 889 Valley Park Drive, Shakopee, MN 55379 Tel (800) 433-9517, www.chemrex.com.
- C. Mastertop CST, Master Builders, 889 Valley Park Drive, Shakopee, MN 55379 Tel (800) 433-9517, www.chemrex.com.
- D. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 MATERIALS

- A. Cure-Seal-Hardener: Water-soluble, silicate based, chemically-reactive penetrating sealer and hardener, that seals by densifying concrete so that water molecules cannot pass through

but air and water vapor can, while allowing concrete to achieve full compressive strength, minimizing surface crazing, and eliminating dusting.

1. Colorless, transparent, odorless, non-toxic, non-flammable.
2. Containing no solvents or volatile organic compounds.
3. USDA approved for food handling facilities.
4. Allowing traffic on floors within 2 to 3 hours, with chemical process complete within 3 months.
5. No change to surface appearance except a sheen developed due to traffic and cleaning.

B. Water: Clean, potable.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared and are suitable for application of product.
- B. If substrate preparation is the responsibility of another installer, notify Architect or unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surface thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. If this is the applicator's first project using this product, provide the manufacturer's technical representative on-site to familiarize installers with proper procedures.
- C. Prevent damage to and soiling of adjacent work.
- D. New Concrete: Apply cure-seal-hardener to new concrete as soon as the concrete is firm enough to work on after troweling, except on colored concrete wait minimum of 30 days.
 1. Spray on at rate of 200 square feet per gallon (4.8 sq m/L).
 2. Keep surfaces wet with cure-seal-hardener for minimum soak-in period of 30 minutes, without allowing drying out or becoming slippery. In hot weather slipperiness may appear before the 30 minute time period has elapsed. If that occurs, apply more cure-seal-hardener as required to keep entire surface in a non-slippery state for the first 15 minutes. For the remaining 15 minutes, mist the surface as needed with water to keep the material in a non-slippery state.

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3. After this period, when treated surface becomes slippery lightly mist with water until slipperiness disappears.
4. Wait for surface to become slippery again and then flush entire surface with water removing all residue of cure-seal-hardener.
5. Squeegee surface completely dry, flushing any remaining slipper areas until no residue remains.
6. Wet vacuum or scrubbing machines may be used to remove residue, provided manufacturer's instructions are followed.

3.4 PROTECTION

- A. Protect installed floors until chemical reaction process is complete, at least three months.
 1. Comply with precautions listed under PROJECT CONDITIONS.
 2. Clean floor regularly in accordance with manufacturer's recommendations.
 3. Clean up spills immediately and spot-treat stains with good degreaser or oil emulsifier.
- B. Precautions and cleaning are the responsibility of the General Contractor until Substantial Completion. Replace concrete that becomes stained due to improper precautions or lack of cleaning.

END OF SECTION 03395

SECTION 05120 - STRUCTURAL STEEL

1.1 GENERAL

- A. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.
- B. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.
- C. Submittals: In addition to Product Data and mill test reports on structural steel and bolts, submit Shop Drawings detailing fabrication of structural steel components, including connections, splices, holes, welds, and bolts.
 - 1. Include Shop Drawings signed and sealed by a professional engineer responsible for their preparation who is legally authorized to practice in the jurisdiction where Project is located and who is experienced in providing structural steel engineering services.
- D. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
 - 2. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
 - 3. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."
 - 1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- F. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.

1.2 PRODUCTS

- A. Structural Steel Angles, Channels, Plates, and Bars: ASTM A 36, carbon steel.
- B. Structural Steel Wide-Flange Shapes, Plates, and Bars: ASTM A 992, Grade 50, high-strength, low-alloy columbium-vanadium steel.

- C. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B.
- D. Anchor Rods, Bolts, Nuts: ASTM A 36.
- E. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers, uncoated.
- F. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.
- G. Nonmetallic, Shrinkage-Resistant Grout: Premixed, ASTM C 1107, of consistency suitable for application.
- H. Fabrication: Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.
 - 1. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
 - 2. Shop install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.
 - 3. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - a. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.
 - 4. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
- I. Shop Priming: Shop prime steel, except surfaces embedded in concrete or mortar, surfaces to be field welded, surfaces to be high-strength bolted with slip-critical connections, and surfaces to receive sprayed-on fireproofing.
 - 1. Surface Preparation: SSPC-SP 6 "Commercial Blast Cleaning."
 - 2. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1.3 EXECUTION

- A. Erect structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.
- B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates and set on wedges, shims, or setting nuts as required.

1. Tighten anchor bolts, cut off wedges or shims flush with edge of base or bearing plate, and pack grout solidly between bearing surfaces and plates.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 1. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.
- E. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
- F. Shop and Field Quality Control: Engage an independent testing and inspecting agency to perform shop and field inspections and tests and to prepare test reports.
 1. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
 2. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
 3. High-strength bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 4. In addition to visual inspection, welded connections will be inspected and tested according to AWS D1.1 procedures.

END OF SECTION

SECTION 07840 – FIRESTOPPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work specified in this section.

1.2 DEFINITIONS

- A. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gasses through penetrations of fire rated wall and floor assemblies.

1.3 GENERAL DESCRIPTION OF THE WORK OF THIS SECTION

- A. Contractor shall field locate all penetrations through rated construction and provide appropriate firestop systems.
- B. Only tested firestop systems shall be used in specific locations as follows:
 - 1. Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
 - 2. Openings between structurally separate sections of walls or floors.
 - 3. Gaps between the top of walls and ceilings or roof assemblies.
 - 4. Expansion joints in walls and floors.
 - 5. Openings and penetrations in fire-rated partitions or walls containing fire doors.
 - 6. Openings around structural members that penetrate floors and walls.

1.4 RELATED WORK OF OTHER SECTIONS

- A. Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:
 - 1. Section 07920 – Joint Sealants.
 - 2. Section 04810 – Unit Masonry Assemblies.
 - 3. Division 15, Fire Protection Sections.
 - 4. Division 16.

1.5 REFERENCES

- A. Test Requirements: ASTM E-814, “Standard Method of Fire Tests of Through Penetration Fire Stops” (July 1997).
- B. Underwriters Laboratories (UL) of Northbrook, IUL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their “FIRE RESISTANCE DIRECTORY” that is updated annually.
 - 1. UL Fire Resistance Directory:
 - a. Through-Penetration Firestop Devices (XHCR)
 - b. Fire Resistance Ratings (BXUV)
 - c. Through-Penetration Firestop Systems (XHEZ)
 - d. Fill, Voids or Cavity Material (XHHW)
 - e. Forming Materials (XHKU)
- C. Test Requirements: UL 2079, “Tests for Fire Resistance of Building Joint Systems” (July 1998).
- D. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgements.
- E. ASTM E-84, Standard Test Method for Surface Building Characteristics of Building Materials.
- F. All major building codes: ICBO, SBCCI, BOCA and IBC.
- G. NFPA 101 – Life Safety Code.
- H. NFPA 70 – National Electric Code.

1.6 QUALITY ASSURANCE

- A. A manufacturer’s direct representative (not distributor or agent) shall be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer’s written recommendations published in their literature and drawings details.
- B. Firestop system installation must meet requirements of ASTM E-814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.
- C. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

- D. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the Contracting Officer prior to penetrating any load bearing assembly.
- E. For those firestop applications that exist for which no UL tested system is available through a manufacturer, an engineering judgement derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgement drawings must follow requirements set forth by the International Firestop Council (September 7, 1994, as may be amended from time to time).

1.7 SUBMITTALS

- A. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions.
- B. Submit shop drawings of UL firestop system assemblies and locations to be applied.
- C. Manufacturer's engineering judgement identification number and drawing details when no UL system is available for an application. Engineer judgement must include both project name and contractor's name who will install firestop system as described in drawing.
- D. Submit material safety data sheets provided with product delivered to job-site.

1.8 INSTALLER QUALIFICATIONS

- A. Engage an experienced installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A supplier's willingness to sell its firestopping products to the contractor or to an installer engaged by the Contractor does not in itself confer qualification on the buyer.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.
- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements, including temperature restrictions.
- D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

- E. Do not use damaged or expired materials.

1.10 PROJECT CONDITIONS

- A. Do not use materials that contain flammable solvents.
- B. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.
- C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- D. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 – PRODUCTS

2.1 FIRESTOPPING, GENERAL

- A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- C. Firestopping Materials are either “cast-in-place” (integral with concrete placement) or “post installed.” Provide cast-in-place firestop devices prior to concrete placement.

2.2 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with through penetration firestop systems (XHEZ) and joint systems (XHBN) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:
 - 1. Hilti, Inc., Tulsa, Oklahoma, 800-879-8000
 - 2. 3M, St. Paul, Minnesota, 800-328-1687
 - 3. Grace Construction Products, 800-778-2880
 - 4. Other manufacturers listed in the U.L. Fire Resistance Directory – Volume 2

2.3 MATERIALS

- A. Use only firestop products that have been UL 1479, ASTM E-814, or UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- B. Cast-in-place firestop devices for use with non-combustible and combustible plastic pipe (closed and open piping systems) penetrating concrete floors, the following products are acceptable:
 - 1. Hilti CP 680 Cast-In-Place Firestop Device
 - 2. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- C. Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
 - 1. Hilti FS-One Intumescent Firestop Sealant
 - 2. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- D. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
 - 1. Hilti CP 601s Elastomeric Firestop Sealant
 - 2. Hilti CP 606 Flexible Firestop Sealant
 - 3. Hilti FS-ONE Intumescent Firestop Sealant
 - 4. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- E. Sealants, caulking or spray materials for use with fire-rated construction joints and other gaps, the following products are acceptable:
 - 1. Hilti CP 672 Firestop Spray
 - 2. Hilti CP 601s Elastomeric Firestop Sealant
 - 3. Hilti CP 606 Flexible Firestop Sealant
 - 4. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- F. Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
 - 1. Hilti FS-ONE Intumescent Firestop Sealant
 - 2. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- G. Intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles, the following products are acceptable:
 - 1. Hilti FS-One Intumescent Firestop Sealant

2. Hilti CP 618 Firestop Putty Stick
 3. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- H. Non-curing, re-penetrable intumescent sealants, caulking or putty materials for use with flexible cables or cable bundles, the following products are acceptable:
1. Hilti CP 618 Firestop Putty Stick
 2. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- I. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:
1. Hilti CP 617 Firestop Putty Pad
 2. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 1
- J. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:
1. Hilti CP 642 Firestop Collar
 2. Hilti CP 643 Firestop Collar
 3. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- K. Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
1. Hilti FS 635 Trowelable Firestop Compound
 2. Hilti FS 657 FIRE BLOCK
 3. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- L. Non-curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
1. Hilti FS 657 FIRE BLOCK
 2. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- M. Sealants or caulking materials used for openings between structurally separate sections of wall and floors, the following products are acceptable:
1. Hilti CP 672 Firestop Spray
 2. Hilti CP 601s Elastomeric Firestop Sealant
 3. Hilti CP 606 Flexible Firestop Sealant
 4. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- N. Provide a firestop system with a “F” Rating as determined by UL 1479 or ASTM E814 which is equal to the time rating of construction being penetrated.