MEDINA PARKING GARAGE
132 N. Elmwood Ave., Medina, OH 44256

SPECIFICATIONS

DESIGN/CONSTRUCTION TEAM

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Medina Parking Structure

Division 03 - Concrete

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SECTION 03 38 16 - UNBONDED POST-TENSIONED CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

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

1.2 DEFINITIONS:

A. Aggressive Environment is an environment in which structures are exposed to direct or indirect applications of the following :

1. Deicing Chemicals
2. Conditions where stressing pockets are wetted or directly in contact with soils.

B. Parking Garage shall be considered as structures operating in an aggressive environment and therefore its components shall be made watertight and protected against corrosion.

1.3 REFERENCES

A. ASTM A416, "Specification for Uncoated Seven-Wire Stress-Relieved Strand for Prestressed Concrete," including supplement, "Low Relaxation Strand".

B. ASTM E328, "Recommended Practice for Stress-Relaxation Tests for Materials and Structures".

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

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

E. CRSI MSP-2, "Manual of Standard Practice".

F. PTI, "Guide Specifications for Post-Tensioning Materials."

G. PTI, "Performance Specification for Corrosion Preventative Coating".

H. PTI, "Specification for Unbonded Single Strand Tendons".

I. PTI, "Field Procedures Manual for Unbonded Single Strand Tendons".

1.4 PRE-INSTALLATION CONFERENCE

A. Discuss pour sequencing, pour strips, tendon locations, sleeve locations, inspections, tendon encapsulating material and procedures, jacking procedures, recording of elongations and cautions regarding cutting or core drilling.

B. Require representatives of each entity directly concerned with the cast-in-place concrete and post-tensioning installation to attend:

1. Contractor's superintendent;
2. Independent testing and inspection agencies;
3. Ready-mix concrete producer;
4. Post-tensioning installer;
5. Concrete subcontractor.

1.5 SUBMITTALS

A. Product Data: Provide data on concrete design mix, admixtures, and other proprietary materials used.

1. Mill tests for prestressing steel and anchorage devices.
2. Typical stress-strain curves for prestressing steel.
3. Tensile strength and elongation at rupture for prestressing steel.
4. Sample of encapsulated anchorage assemblies.

B. Shop Drawings: Submit shop drawings for the work in this Section sealed by a Structural Engineer who is legally qualified to practice in jurisdiction where project is located. Indicate layout, tendon sizes, grouping, spacing, placing sequences, corrosion preventive coating, sheathing, anchorage details, supports and locations, tendon supports, accessories, clearances required for jack, and pressure plate stresses.

1. Describe tensioning sequences; type of jack; pressure monitoring device; tendon cut-off procedures; method of sealing tendons; encapsulated connections between tendons and anchorages; jacking force and jacking pressures; and maximum temporary jacking force and jacking pressures.
2. Describe pour sequences indicating pour strips (if required), and splices and couplers (if required).

C. Sealed calculations, prepared under supervision of qualified, professional, legally registered Structural Engineer in jurisdiction where project is located, of losses due to anchorage seating, elastic shortening, creep, shrinkage, relaxation, friction, and wobble, used to determine tendon sizes and number. Friction and wobble coefficients shall be in accordance with PTI recommended values unless test data submitted to substantiate lower values.

D. Certificate: Certify that tendon strength characteristics meet or exceed specified requirements.

E. Project Record Documents: Record actual locations of tendons; stressing sequence and tension loads established, and theoretical and actual elongation of tendons and jack and gauge identification numbers on approved forms.

1. Submit copies of post-tensioning records promptly upon completion of each member or slab tensioning run.
2. Do not cut or cover tendon ends until Contractor has received Engineer's written review of post-tensioning records.

1.6 QUALITY ASSURANCE

A. All work shall conform to Post Tensioning Institute (PTI) Manual standards entitled "Specification for Unbonded Single Strand Tendons for Minimum Requirements".

B. Work shall conform to requirements of ACI 301, ACI 318, and CRSI MSP-2 except where more stringent requirements are shown on Drawings or specified in this Section.

C. Welders and welding procedures shall conform to requirements of AWS D1.1 and AWS D1.4. Welding prohibited except where shown on Drawings or accepted in writing by Owner.

1. Welders shall be qualified within previous 12 months in accordance with AWS B2.1.

D. Inspection of reinforcing steel and post-tensioning reinforcement is required. Inspection shall be conducted by inspection agency employed by Owner and approved by Engineer. Inspectors shall have completed a minimum of 5 years of inspecting post-tensioned structures of which 3 must be parking garages. Prior to placing concrete, inspector shall provide reports in accepted format with copy to Owner and Architect. Inspection agency has authority to reject reinforcement not meeting Contract Documents and accepted Shop Drawings.

E. Post-tensioning supplier shall have successfully provided all materials for not less than 5 previous post-tensioning installations in parking structures with structural system similar to this project in previous 5 years.

F. Installer shall have successfully performed not less than 5 previous post-tensioning installations in parking structures with structural system similar to this project in previous 5 years.

G. Post-tension supplier shall have superintendent periodically on site to supervise and ensure consistent and correct installation.

H. All post-tensioning Work shall be under immediate control of person experienced in this Work. Exercise close check and rigid control of all operations as necessary for full compliance with all requirements. Post-tensioning Contractor's superintendent assigned to Project shall have supervised 5 prior parking garage projects of similar magnitude and design, shall be present during all placing and post-tensioning operations, shall exercise close check and control of all operations as required for full conformance to requirements. Superintendent shall be acceptable to Owner. Superintendent's failure to ensure full compliance with Specification will result in removal from Project.

I. Workers performing installation shall be PTI Certified.

J. Contractor: Keep a copy of PTI "Field Procedures Manual for Unbonded Single Strand Tendons" on site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Supplier: Assign all post-tensioning tendons within every group or in same member heat number and tag accordingly.

B. Supplier: Package each tendon coil at source in heavy plastic, sealed shut, to prevent physical damage to tendon during transportation and storage and to positively protect strand from moisture and corrosion during transit and storage. Use heavy padding such as carpeting to protect sheathing from being cut by binding materials. Use filament tape, not wire binding. Cardboard unacceptable. No part of any tendon shall ever be unprotected against moisture. Corrosion inhibitor coated bare strand unacceptable.

C. Contractor: Inspect all tendons before unloading. Store properly.

D. Supplier: Remove and replace at no cost to Owner tendons with wires or strands which are broken or show severe fabrication defects.

E. Plastic on the stressing tail to be removed only on the day of stressing. Special cutting tool or approved equal shall be used for the removal of the sheathing.

F. Contractor/Installer: Do not store material on slabs to be prestressed before final prestress of slabs is accomplished. At no time shall weight of stored material placed on slab area,

after prestressing is completed and concrete has reached specified 28 day strength, exceed total design load of that slab area. Between time final post-tensioning is accomplished and time concrete has reached specified 28 day strength, weight of stored material placed on slab area shall not exceed half total design load of that slab area.

PART 2 - PRODUCTS

2.1 POST-TENSIONING MATERIALS

A. Post tensioning materials that are exposed to an aggressive environment shall comply with this specification and the following requirements;

1. Post tensioning material shall provide a complete encapsulated system, which has demonstrated the ability to remain watertight when subject to a hydrostatic pressure of 125 psi for a period of 24 hours.

2. Exposed components shall be protected within one working day after their exposure during installation except that caps and sleeves shall be installed within one day after the acceptance and approval of the elongation records by the Engineer.

3. Stressing-end anchorages shall have the tendon tail and the gripping part of the anchorage capped at the anchor cavity to completely seal by filling the caps with PT coating to protect the area against moisture.

4. Fixed end anchorages shall be covered at the anchor cavity wit a watertight cap. The cap shall be shop installed after coating and filling the tendon tail and wedge areas with PT coating.

5. Couplers shall have a watertight connection between the sleeving and the tendon sheathing. Coupler sleeving shall not contain air voids.

6. Sheathing connection to sleeving at couplers, to all stressing end, intermediate and fixed end anchorages shall be watertight and free of air voids.

B. Post-tensioning tendons, ASTM A416: Seven-wire, uncoated low relaxation stress relieved steel strand, Grade 270; all strand shall be manufactured by single source.

C. Sheathing: Make tendon sheathing for unbonded single strand tendons of material with following properties:

1. Sufficient strength to withstand unrepairable damage during fabrication, transport, installation, concrete placement and tensioning.

2. Water tightness over entire sheathing length;

3. Chemical stability, without embrittlement or softening over anticipated exposure temperature range and service life of structure.

4. Non-reactive with concrete, steel, and tendon corrosion preventive coating.

5. Color shall contrast with black corrosion preventive coating so that sheathing tears will be readily visible. Black/dark colored sheathing is unacceptable.

6. Sheathing: seamless and extruded high density polypropylene or seamless and extruded high density polyethylene. Density $\geq$ 0.95.

7. Sheathing thickness: min. 50 mil thickness –0+15 mils.

8. Inside diameter: at least 0.030 in. greater than maximum diameter of strand.

9. Make all connections and components watertight, providing a complete encapsulation of the prestressing steel.

D. Tape:

Encapsulated systems using tape as a component, the tape component must demonstrate the ability to past the hydrostatic water test. Tape repair procedures shall conform to the "Field Manuel For Unbonded Single Strand Tendons"

1. "3M Tape No. 226," 3M, St. Paul, MN.
2. "Patch #145 Vinyl – Rubber Adhesive," 3M, St. Paul, MN.
3. "Polyken, Type 826," Kendall Co., Boston, MA.
4. "PWT-20, Alltape," Hialeah, FL.

E. Tendon corrosion inhibiting coating: Lithium-based, containing corrosion inhibitors, wetting agents, and less than 50 parts per million of chlorides, sulfides or nitrates:

1. Acceptable corrosion inhibiting coatings:
   a. "Shell PT Grease," Shell Oil Company, West Orange, New Jersey.
   a. "Visconorust PT 1000," Viscosity Oil Division of Tenneco, Chicago, Illinois.
   b. "Visconorust PT 1001," Viscosity oil Division of Tenneco.
   c. "Mobil Creasrex K218," Mobil Oil Company, Houston, Texas.
   d. "Unocal PT1 Cable Grease," Unocal Corporation, Schaumburg, Illinois.
   e. "Century PT," Fuchs Lubricants Company, Marion, Illinois.
2. Corrosion inhibiting coating shall completely fill void between tendon and sheathing.
3. Minimum weight of corrosion inhibiting coating on tendon strand shall be 2.5 lb per 100 ft of 0.5 in. diameter strand, and 3.0 lb per 100 ft of 0.6 in. diameter strand.
4. Corrosion inhibiting coating shall meet all requirements of PTI "Performance Specification for Corrosion Preventive Coating."
5. P-T coating manufacturer or distributor shall provide evidence that the coating has been tested within 5 years to determine if any chemical changes have been made to their components during that period.
6. P-T coating shall satisfy the following requirements:

Table 1 - Performance Specification for P-T Coating.

#	Test Description	Test Method	Acceptance Criteria
1	Dropping point	ASTM[b] D566 or ASTM D2265	Minimum 300°F [149°C]
2	Oil separation at 160°F [71°C]	FTMS[c] 791B Method 321.2	0.5% max by mass
3	Water content	ASTM D95	0.1% maximum
4	Flash point (Refers to oil component)	ASTM D92	Minimum 300°F [149°C]
5	Corrosion test (5% salt fog at 100°F [38°C] 5 mils [127 micro-m], Q Panel Type S)	ASTM B117	Rust Grade 7 or better after 1000 hours of exposure according to ASTM D 610
6	Water-soluble ions[a] a. Chlorides b. Nitrates c. Sulfides	 ASTM D512 ASTM D3867 APHA[d] 4500-S^{2}E	 10 ppm maximum 10 ppm maximum 10 ppm maximum
7	Soak test (5% salt fog at 100°F [38°C] 5 mils [127 micro-m] coating, Q Panel Type S. Immerse panels 50% in a 5% salt solution and expose to salt fog)	ASTM B117 (modified)	No emulsification of the coating after 720 hours of exposure.
8	Compatibility with sheathing a. Hardness and volume change of polymer after exposure to grease, 40 days at 150°F [66°C] b. Tensile strength change of polymer after exposure to grease, 40 days at 150°F [66°C]	 ASTM D4289 (ASTM D792 for density) ASTM D638	 Permissible change in hardness 15%, volume 10%. Permissible change in tensile strength 30%.

F. Couplings: In accordance with ACI 301 Prestressed Concrete Section, heading "Couplings" where indicated on Drawings or specified by Owner. Completely fill with PT corrosion inhibiting coating.

G. Tendon Anchor: Type compatible with tendon, of strength to develop 100% of the minimum specified ultimate strength of the prestressing steel. Limit strand slippage at full applied load to less than 1/8 inch.

H. Distribution plates: Welded steel or cast steel bearing assemblies where required to support and distribute load from anchorage devices as follows:

1. Do not exceed the maximum concentrated bearing stress in the concrete permitted by ACI 318.

2. Bending stresses in the plates induced by the pull of the prestressing steel shall not exceed 20,000 psi for structural steel and 15,000 for cast steel, except if acceptable test data indicates that higher stresses are satisfactory.

3. Design, fabrication and erection shall meet the latest AISC Standards and Welding AWS Standards including Qualification Test of Welders.

4. Provide materials which meet requirements of ASTM A36 for structural shapes, or ASTM A148 for cast steel.

5. Bolts, nuts and washers: ASTM A325 galvanized to ASTM A153/A.

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

I. Blockouts: Use plastic pocket former at stressing end to provide 2 in. minimum recess to anchor casting and 3 in. minimum width to allow access to cut off excess strand. At intermediate stressing ends, use grommet to prevent moisture leaks into anchor casting or tendon sheathing.

J. Anchor Cap:

1. Stressing End: Plastic cap shall fit tightly, covering stressing end of barrel and wedges, and shall be fitted with sealing device. Cap shall allow minimum 1.25 in. protrusion of strand beyond wedges.

2. Intermediate Stressing Ends: Plastic cap similar to above shall be used with exception that cap shall be open to allow passage of strand with minimum 0.75 in chimney extension of cap.

3. Coating Material: Wedge area and plastic cap shall be completely filled with same corrosion preventive coating used along length of strand.

4. Plastic cap shall have positive mechanical connection to anchor. Friction fit is not acceptable.

K. Design Forces and Stresses:

1. Effective post-tensioning forces, after all losses have occurred, are shown on drawings.

2. Maximum tensile stress in post-tensioning tendons due to jacking forces shall not exceed 80% of specified tensile strength or 94% of specified yield strength of post-tensioning tendon, whichever is smaller, but not greater than maximum value recommended by manufacturer of post-tensioning tendons.

3. Maximum tensile stress in post-tensioning tendons immediately after anchorage shall not exceed 70% of specified tensile strength.

4. Allowable slip of strand at anchorage shall not exceed .125 in. Measured elongation shall be within $\pm$7% of calculated.

5. Design effective prestressed force shown on Drawings and design moment strength of all post-tensioned sections are based on effective stress of 173,000 psi in prestressed reinforcement after all allowance for all prestress losses.

2.2 GROUT MATERIALS

A. Nonmetallic Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with ASTM C 1107, Grade B, with fluid consistency and a 30-minute working time.

B. Products: Subject to compliance with requirements, provide one of the following:

Nonmetallic Shrinkage-Resistant Grout:

a. Sure Grip Grout, Dayton Superior.

b. Euco N.S., Euclid Chemical Co.
c. Masterflow 928, Master Builders, Inc.

2.3 ACCESSORIES

A. Tie Wire:

1. Minimum 16 gage annealed type.

2. An acceptable patented system.

B. Chairs, Bolsters, Bar Supports, Spacers: Size and shape for strength and support of reinforcement during tendon location, installation, and placement of concrete.

C. Markers: Colored plastic.

D. Touch-up Primer: Corrosion resistive paint.

2.4 CONCRETE MATERIALS AND MIX DESIGN

A. Concrete Materials: As specified in Section 03 30 00.

B. Mix Design Requirements and Limitations and Proportioning Methods: As specified in Section 03 30 00.

2.5 FORMWORK

A. Formwork: As specified in section 03 30 00.

PART 3 - EXECUTION

3.1 PREPARATION

A. Furnish necessary information, materials, accessories and other items for prestressing and attaining effective post-tensioning forces, after all losses have occurred, as shown on Drawings and specified in the this Section.

B. Maintain post-tensioning equipment in safe, working condition.

C. Satisfactorily protect post-tensioning tendons from rust or other corrosion before placement. Provide sufficient protection for exposed prestressing steel at ends of members to prevent deterioration by rust or corrosion. No exposed strand is permitted at any time during shipping or casting. Cut ends shall receive a protective cap in order to prevent water to be drawn into tendon by means of capillary action. Any stripped sheathing on the stressing tail has to be replaced.

3.2 INSTALLATION

A. Placement:

1. Place tendons with reverse parabolic profile in vertical plane conforming to control points shown on Structural Drawings unless otherwise specified:

a. Dimensions locating profile are given to center of gravity of tendons.

b. Low points are at midspan unless noted otherwise. Provide positive support at tendon low points.

c. Where tendons interfere with one another, contact Engineer before relocating tendons.

d. Support slab tendons independently of beam reinforcement.

2. Space tendons evenly within slab to achieve required effective prestress, or as shown on Structural Drawings.
   a. Prohibited: Bundling of more than two slab tendons without prior written permission from Engineer.
3. Straighten strands to produce equal stress in all tendons that are to be stressed simultaneously and to insure proper positioning of anchors.
4. Run tendons full length within pour without splices or couplers.
5. Install horizontal and vertical spacers or chairs to hold tendons in required position and to conform to specified profile.
6. Space tendon support chairs at 42 in. maximum.
7. Tendons and anchorages shall be supported firmly to prevent displacement during subsequent operations.
8. Place tendons and anchorages to both horizontal and vertical tolerances for corresponding horizontal and vertical member dimensions:
   a. 8 in. and less: $\pm$ 0.125 in.
   b. 8 to 24 in.: $\pm$ 0.375 in.
   c. Greater than 24 in.: $\pm$ 0.5 in.
   d. Deviations in horizontal plane which may be necessary to avoid openings or inserts shall have radius of curvature $\geq$ 21 ft.
9. Openings: Provide at least 6" of concrete between tendons and openings in slabs. Provide reinforcing steel at corners of openings.
10. Install plastic coated conduit in slabs where shown. Provide a minimum of 1½" cover below top of slab and 1" of cover on the bottom of slab. Do not bundle conduits. Do not move or displace any post-tensioning tendons or reinforcing bars to accommodate conduit runs. All conduit locations are subject to approval by Engineer.
11. Secure jack pressure plates in position perpendicular to line of stressing force.
12. Stressing anchorages shall be installed perpendicular to tendon axis. Curvature in tendon profile shall not be closer than 3 ft from stressing anchorage.
13. Stressing anchorages shall be rigidly attached to bulkhead forms. Connections shall be sufficiently rigid to avoid accidental loosening due to construction activity or during concrete placement.
14. Pocket formers at stressing and intermediate stressing anchorages shall positively preclude intrusion of concrete or cement slurry into wedge cavity during concrete placement. Depth of pocket former from exterior edge of concrete to closest surface of wedge cavity area of anchor shall not be less than, 2 inches.
15. Satisfactorily protect post-tensioning tendons from moisture, rust or other corrosion prior to placement of concrete. Provide protection for exposed prestressing steel at ends of members and at intermediate anchorages to prevent water from getting on or into tendons and sheathing at all times during construction. Provide watertight assembly at intermediate anchorages within 24 hrs of stressing operations.

B. Sheathing Inspection and Repair:

1. After installing tendons in forms and before concrete casting, sheathing shall be inspected for possible damage.

1. Damaged areas shall be repaired by restoring corrosion preventive coating in damaged area, and repairing sheathing to satisfaction of Engineer.
2. Sheathing repair procedure:
    a. Restore tendon corrosion preventive coating in damaged area.
    b. Coat with corrosion preventive coating outside of sheathing length of damaged area, plus 2 in. beyond each end of damage. Example: If sheathing tear is 6 in. long, then corrosion preventive coated area will be 10 in. long, centered on tear.
    c. Place piece of longitudinally slit sheathing around corrosion preventive coated tendon. Slit shall be on side of tendon opposite tear. Length of slit sheathing shall overlap corrosion preventive coated area by 2 in. at each end. Example: If corrosion preventive coated area is 10 in. long, then sheathing will be 14 in. long, centered on tear.
    d. Tape entire length of slit sheathing, spirally wrapping tape around sheathing to provide at least 2 layers of tape. Taping shall overlap slit sheathing by 2 in. at each end. Before taping, sheathing shall be dry and free of corrosion preventive coating. Example: If slit sheathing is 14 in. long, then taped area will be 18 in. long, centered on tear.
3. Any damage to shop assembled tendon encapsulating system, such as sheathing tears or cuts (beyond that specified as repairable), sheathing withdrawn from connecting sleeves, or connecting sleeves withdrawn from dead end anchorage shall be cause for rejection by Engineer.

C. Tensioning: All tensioning operations shall be performed under continuous inspection by Special Inspector.
1. Take safety precautions to prevent workers from standing behind or above jacks during tensioning.
2. Perform tensioning after concrete has reached 3000 psi compressive strength.
    a. Stress tendons within 96 hours after placing concrete.
    b. Confirm concrete strength with test cylinders prior to tensioning.
3. Jacks: Stress tendons by means of hydraulic jacks, equipped with accurate reading calibrated hydraulic pressure gauges to permit the stress in the prestressing steel to be computed at any time. A certified calibration curve from a recognized testing laboratory shall accompany each jack.
4. Stressing:
    a. No stressing will be permitted until it is demonstrated that the prestressing steel is reasonably free and unbonded in the enclosure.
    b. Tendon force measured by gauge pressure must agree within 5% with the tendon force calculated by elongation measurement. If consistencies between the measured elongation and the jack gauge reading occur, immediately recalibrate the jack gauges.
    c. Individual tendon elongations shall be within 5% of that calculated. The total tendon elongation sum of any structural member or system shall be equal to the average calculated elongation of all tendons required by the member or system times the total number of tendons required by the member or system plus or minus 2%. The Contractor shall be responsible for retensioning of elements until such criteria is satisfied.
    d. Anchor the prestressing steel at an initial or anchor force or stress that will result in the final tension of the working or effective force or stress indicated. In no case may the steel be tensioned above 80% of the ultimate strength of the

strand. The calculated anchor force shall not exceed 70% of the ultimate strength of the strand. The Contractor shall be responsible for providing additional reinforcing steel required at anchorages due to enclosure forces.

e. Jack against tendon pressure plate, not against concrete.

D. Cutting Tendons After Stressing:

1. Do not cut tendons or cover pockets until elongation records are reviewed and accepted by Engineer.

2. Clean tendons, anchorages and pockets of corrosion preventive coating with non-corrosive solvent before removal of excess length of post-tensioning tendons.

3. Each tendon shall be cold-sheared by "PocketShear," by the Adrian Corporation, (972) 247-4454, or equal, within the pocket. The strand length protruding beyond the wedges after cutting the tendon tail shall be no less than 0.75 in. All tendon ends shall be left clean and free of burrs.

4. Do not damage tendon, anchorage or concrete during removal of excess length of tendon.

5. Coat the exposed strand and wedge areas with a coating material comparable to that used over the length of the tendon and a watertight cap shall be applied over the coated areas.

6. Apply a resin bonding agent to the inside surfaces of the pocket and then fill with a non-shrink grout that does not contain any chlorides or other chemicals known to be deleterious to the prestressing steel.

7. Stressing pockets shall be filled with non metallic non shrink grout within 10 days after tendon tail cutting.

E. Minimum Cover Requirements:

1. Exterior edge of concrete to wedge cavity area of anchor 2"

2. Tendon tail cover to encapsulating device 1"

3. Exterior edge of concrete to intermediate anchor cavity 2"

3.3 FIELD QUALITY CONTROL

A. Contractor: Inspect tendons after installation. Reject, repair or replace nonconforming work.

B. Encapsulated tendons shall not be exposed to weather more than 7 calendar days prior to concrete placement. Bare strand never permitted.

C. Tendon sheathing damaged over more than 10% of length shall be rejected. Damaged length need not be continuous.

D. Before concrete placement around sheathing, all tendon damage shall be repaired to watertight condition. Repairs shall be acceptable to Engineer.

E. Inspect sheathing for unrepaired damage, for watertight seal between sheathing and anchor, and for correct installation of anchors, before concrete is placed around tendons.

F. Relative wedge embedment into anchor shall not exceed 0.375 in.

3.4 PROTECTION

A. After removing excess length of tendon, exposed end of tendon and chucks shall be made watertight immediately by covering with approved corrosion preventive coating-filled tendon cap, or by other acceptable methods.

B. After sealing exposed end of tendon and chucks, and before grouting tendon pocket, coat pocket surfaces with bonding agent.

C. Grout tendon pockets solid with non-shrink, non-stain, chloride free grout as specified in this Section.

3.5 EXTRA STOCK

A. Maintain on site adequate supplies of repair tape and tendon corrosion preventive coating to make repairs.

B. Maintain spare jack on site during post-tensioning operations.

3.6 REPAIRS

A. General Contractor: Responsible for all repairs.

B. Post-tensioning Contractor: Submit repair procedures to Engineer for evaluation and acceptance.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specifications apply to work in this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Floors and slab on grade.
   2. Cast-in-place post tensioned slabs and beams.
   3. Concrete foundation walls and footings.
   4. Tower walls and stairs.
   5. Joint devices associated with concrete work.
   6. Miscellaneous concrete elements.

1.3 RELATED SECTIONS

A. Section 03 38 16- Unbonded Post Tensioned Concrete.

B. Section 03 39 00- Concrete Curing

C. Section 07 18 00- Traffic Coatings

D. Section 07 19 00- Water Repellents

E. Section 07 92 00- Joint Sealers

F. Section 07 95 00- Expansion Control

1.4 REFERENCES

A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).

B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 1999.

C. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2004.

D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.

E. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 1999.

F. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 1988.

G. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary; American Concrete Institute International; 2005.

H. ASTM C 33 - Standard Specification for Concrete Aggregates; 2003.

I. ASTM C 39/C 39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2003.

J. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2003a.

K. ASTM C 143/C 143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2003.

L. ASTM C 150 - Standard Specification for Portland Cement; 2002a.

M. ASTM C 173/C 173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2001.

N. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2001.

O. ASTM C 494/C 494M - Standard Specification for Chemical Admixtures for Concrete; 2004.

P. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2003.

Q. ASTM C 1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 1999.

R. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 1999.

S. ASTM E 1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 1997.

1.5 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: Submit mix design for each type of concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

E. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Cementitious materials and aggregates.
2. Form materials and form-release agents.
3. Steel reinforcement and reinforcement accessories.
4. Fiber reinforcement.
5. Admixtures.
6. Curing materials.
7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.
10. Epoxy joint filler.

11. Joint-filler strips.
12. Repair materials.
13. Waterstops.

1.6 QUALITY ASSURANCE

A. 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.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.

1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

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, each aggregate from one source, and each admixture from the same manufacturer.

E. ACI Publications: Comply with the following, unless more stringent provisions are indicated:

1. ACI 318, "Specification for Structural Concrete."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code – Reinforcing Steel".

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Avoid damaging coatings on steel reinforcement.
2. Repair damaged epoxy coatings on steel reinforcement according to ASTM D 3963/D 3963M.

PART 2 – PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch minimum.

F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plan of the exposed concrete surface.

2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Reinforcing Bars to be Welded: ASTM A706/A706M, deformed.

C. Epoxy-Coated Fabricated Reinforcing Bars: ASTM A 934/A 934M, and as follows:

1. Steel Reinforcement: ASTM A 615/A 615M, Grade 60, deformed.

D. Steel Bar Mats: ASTM A 184/A 184M, assembled with clips.

1. Steel Reinforcement: ASTM A 615/A 615M, Grade 60, deformed bars.

E. Plain-Steel Wire: ASTM A 82, as drawn.

F. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

G. Galvanized Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from galvanized steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric 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. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless steel-bar supports.

2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

B. Joint Dowel Bars: Plain-steel smooth round bars, ASTM A 36. Cut bars true to length with ends square and free of burrs.

C. Epoxy-Coated Joint Dowel Bars: ASTM A 775/ with ASTM A 36, plain-steel round bars.

D. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I.

B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:

1. Class: Severe weathering region, but not less than 3S.
2. Nominal Maximum Aggregate Size: 1-1/2 inches for piers and foundations.
3. Nominal Maximum Aggregate Size: 1 inch for walls, columns, beams and slab on grade.
4. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 sieve, and less than 8 percent may be retained on sieves finer than No. 50.

C. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.05 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

B. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures. Provide one of the following:

a. "AEA-92 or Air 40" by The Euclid Chemical Company
b. "Sika Aer" by Sika Corp.
c. "MB-VR or MB-AE" by Master Builders.

C. Water-Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.05 percent chloride ions. Provide one of the following:

a. "Eucon MR or Eucon WR 91" by The Euclid Chemical Company
b. "Pozzolith 322N" by Master Builders.
c. "Plastocrete 160" by Sika Chemical Corp.

D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F or Type G and containing not more than 0.05 percent chloride ions. Provide one of the following:

a. "Eucon 37/Eucon 1037, or Plastol 341/5000" by The Euclid Chemical
b. "Daracem 100or Adva Flow" by W.R. Grace
c. "Rheobuild 1000 or Glenium 3030" by Master Builders.

E. Non-Chloride, Non-Corrosive Accelerating Admixture: The admixture shall conform to ASTM C 494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Provide one of the following:

a. "Accelguard 80, 90, or NCA" by The Euclid Chemical Company.

F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D, and contain not more than 0.05 percent chloride ions. Provide one of the following:

a. "Eucon NR or Eucon Retarder 100" by The Euclid Chemical Co.

b. "Pozzolith Retarder" by Master Builders.

c. "Plastiment" by Sika Chemical Company.

G. Corrosion-Inhibiting Admixture: 30% calcium nitrite (to all supported slabs and beams).

1. Add at a rate of 2-1/2 gal/cu.yd. of concrete.

2. Products: Subject to compliance with requirements, provide one of the following at 3 gal/cy:

a. Eucon CIA by The Euclid Chemical Company

b. DCI or DCI-S; W. R. Grace & Co., Construction Products Div.

c. Rheocrete CNI Master Builders, Inc.

H. High Range, Water Reducing, and Retarding (Superplasticizer): ASTM C494, Type G. Provide one of the following:

a. Eucon 537 by The Euclid Chemical Company.

b. Daracem 100 by W.R. Grace.

c. Rheobuild 916 by Master Builders.

I. Certification: Written conformance to the above-mentioned requirements and the chloride ion content of admixtures will be required from the admixture manufacturer prior to mix design review by the Engineer.

J. Prohibited Admixtures: Calcium chloride thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.

2.6 WATERSTOPS

A. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricated corners, intersections and directional changes. Profile: Flat, dumbbell without center bulb.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. PVC Waterstops:

a. Greenstreak

b. Meadows: W.R. Meadows, Inc.

c. Murphy: Paul Murphy Plastics Co.

d. Progress Unlimited Inc.

e. Sternson Group

f. Tamms Industries Co.; Division of LaPorte Construction Chemicals North America, Inc.

g. Vinylex Corporation

h. Westec Barrier Technologies; Division of Western Textile Products, Inc.

2.7 RELATED MATERIALS

A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Bonding and Repair Materials:

1. Bonding Admixture: The compound shall be a latex, non-rewettable, polymer modified, bonding grount containing an acrylic or styrene butadiene bonding admixture. Provide: "Flex-Con" by The Euclid Chemical Company, "SBR Latex" by The Euclid Chemical

Company or "Daraweld C" by W.R. Grace.

2. Polymer Patching Mortar: Polymer and microsilica modified cementitious based compounds. Products:

   Horizontal: "Thin Top Supreme, Concrete Top Supreme" By The Euclid Chemical Company or "Sika 121 or 122" by Sika Chemical.

   Vertical or Overhead: "Verticoat/Verticoat Suprement" by The Euclid Chemical Company or "Sikatop 123" by Sika Chemical.

3. High Strength Repair Mortar: For forming and pouring structural members, or large horizontal repairs, provide the flowable one-part, high strength microsilica modified repair mortar with 3/8" aggregate. The product shall achieve 9000 psi @ 28-days at a 9-inch slump. Provide "Eucocrete" by The Euclid Chemical Co. or "Euco Speed MP" (Cold Weather) by The Euclid Chemical Co

C. Epoxy-Bonding Adhesive: ASTM C 881, two-component, 100% solids, 100% reactive compound suitable for use on dry or damp surfaces.

1. Provide one of the following:

   a. "Euco #452 Series or Duralcrete" by The Euclid Chemical Company.

   b. "Sikadur Hi-Mod Series" by Sika Chemical.

2.8 REPAIR MATERIALS

A. Repair Underlayment: Free-flowing, self-leveling, pumpable cementitious base compound.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

5. Provide: "Flo-Top or Super Flo-Top" by The Euclid Chemical Co. The compound shall exhibit the following properties:

Compressive Strength (ASTM C109)	- 3600 PSI @ 7 days - 5000 PSI @ 28 days
Bond Strength (ASTM C1042)	- 700 PSI @ 7 days - 1000 PSI @ 28 days

B. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

5. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.

6. Compressive Strength: Not less than 5700 psi at 28 days when tested according to ASTM C 109/C 109M.

7. Self-leveling, polymer modified high strength topping. Product shall be "Thin-Top Supreme" by The Euclid Chemical Company. The topping shall exhibit the following properties: Chaplin Abrasion Test – 0.02 mm (0.0079") maximum @ 28 days (British

Standard 8204).

2.9 CONCRETE MIXES

A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.

C. Footings and Foundation Walls: Proportion normal-weight concrete mix as follows:

1. Compressive Strength (28 Days):
   a. 4,000 psi for spread footings.
   b. 4,000 psi with w/c ratio .40 maximum for pile caps and footings.
   c. 4,000 psi with w/c ratio of .40 maximum for grade beams, pilasters and walls. No air entrainment required below grade.
2. Maximum Slump:
   a. Other reinforced foundation systems: not less than 1" and not more than 3".
   b. Ramps and sloping surfaces: not more than 3".
   c. All other concrete: not less than 1" and not more than 4".
3. Maximum Slump for Concrete Containing High-Range Water-Reducing Admixture: 9 inches after admixture is added to concrete with 2- to 3-inch water slump (3 inch - 4 inch for lightweight concrete).

D. Slab-on-Grade: Proportion normal-weight concrete mix as follows:

1. Compressive Strength (28 Days): 4,500 psi.

E. Elevated Slabs, Beams and Columns: Proportion normal-weight concrete mix as follows:

1. Compressive Strength (28 Days): 5000 psi. with a maximum w/cm 0.40
2. Maximum Slump: 8 inches after addition of High Range Water Reducing Admixture to concrete with 3-inch water slump.
3. All columns, beams and elevated slab concrete to conform to ACI 318R-14 / R19.3.

F. Cementitious Materials (Contractor has the option of selecting ONE of the following): For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements, but not greater than:

1. Fly-Ash – Class C: Twenty-five percent (25%)
2. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120 may be used up to a maximum of 40% of the total cementitious content.

E. Maximum Water/Cementitious Materials Ratio: 0.40 for corrosion protection of steel reinforcement in concrete exposed to chlorides from deicing chemicals, salt, saltwater, brackish water, seawater, or spray from these sources.

F. Air Content: Add air-entraining admixture to all concrete except in grade beams and pile caps, at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:

1. Air Content: 5.5 percent for 1-1/2-inch- nominal maximum aggregate size.

2. Air Content: 6 percent for 1-inch- nominal maximum aggregate size.

3. Air Content: 6 percent for 3/4-inch- nominal maximum aggregate size.

4. Air Content: 3 percent maximum for interior trowel finished slabs.

G. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement for reinforced concrete.

H. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use high range water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, fiber concrete, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.40.

2.10 FABRICATING REINFORCEMENT

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

2.11 CONCRETE MIXING

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

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3. 1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.

1. Design and engineering of formwork are Contractor's responsibility.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch for exterior and interior formed concrete exposed to view or to be covered with a coating or covering material applied directly to concrete such as waterproofing, dampproofing or painting.

2. Class B, 1/4 inch for formed concrete to be permanently exposed, but not prominently to public view.

3. Class D, 1 inch for formed concrete to be permanently concealed.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces.

Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

1. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor bolts, accurately located, to elevations required.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.

B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:

1. At least 75 percent of 28-day design compressive strength.

2. Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to ACI 301.

3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete

surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318, ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.

B. Plan sequence of removal of shores and reshores to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least two mesh spacings. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement (when required): Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at floor slabs.
4. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
5. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Form from preformed plastic keyway – section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

E. Dowel Joints: Provide diamond dowels at all construction joints of non-reinforced slabs and PD³ Load Plate Baskets under saw cuts where noted on the drawings.

3.7 WATERSTOPS

A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of work. Field-fabricate joints in waterstops according to manufacturer's written instructions.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Architect.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.

D. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. 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, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Use only specified non-corrosive accelerator. Calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.

G. 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 below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.
3. Use evaporation retarder as required to minimize crusting and plastic cracking when subject to wind, high temperature, and low humidity.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.

C. Rubbed Finish: Apply the following to smooth-formed finished concrete where noted:

1. Exposed wall surfaces: Provide grout cleaned finish complying with the following:

a. Begin cleaning operations after all contiguous surfaces to be cleaned are accessible and properly prepared for finishing.

b. Grout: Use one-part Portland cement and 1-1/2 part fine sand mixed with sufficient water to produce a grout with the consistency of thick paint.

c. Wet concrete surface to limit absorption of water from the grout; apply grout uniformly with brushes or rubber floats.

d. Immediately after application of grout, scrub surface vigorously with firm rubber float to coat the surface and completely fill air bubbles and holes.

e. While grout is still plastic, remove excess grout by working surface with cork float.

f. After the surface whites from initial drying (about 30 minutes at normal temperatures), rub vigorously with clean burlap.

g. Immediately after finishing, apply water mist to wall surfaces; maintain damp surface for at least 36 hours after final rubbing.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing.

C. Broom Finish: Apply a broom finish to all parking slabs, and elsewhere as indicated. Broom finish shall run parallel to the length of the beams.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

D. Non-Slip "Light Broom" Finish: Apply a non-slip "light broom" finish to all stair treads, landings, elevator lobbies, Storage room and Electrical Room.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom in direction to be determined by Architect. Coordinate required final finish with Architect before application. Provide a mock up of proposed finish for Architect viewing.

E. Hard Trowel Slab Finish: Apply a hard trowel uniform finish to all slabs in the Terminal area and wash bays of Bus wash bays.

1. Apply trowel finish to monolithic slab surfaces that are exposed to view or are to be covered with flooring, paint or other thin film coating.
2. Consolidate concrete surfaces by finish troweling, free of trowel marks, uniform in texture and appearance.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades in is place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete work.

B. Curbs: Provide Monolithic finish in interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.12 CONCRETE PROTECTION

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 with recommendations in ACI 305R for hot-weather protection during curing.

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and

stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, pop outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01-inch-wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with the specified polymer patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
6. Repair random cracks that have little movement as noted below.
   a. Repair isolated random horizontal cracks less than 0.01 in. wide, using approved silane sealer product.
   b. Repair isolated random horizontal cracks 0.01 in to less than 0.03 in. wide, using approved methyl methacrylate product.
   c. Repair isolated random horizontal cracks 0.03 in. to 0.06 in. wide: route and seal with approved sealer product.
   d. Repair isolated random vertical cracks more than 0.01 in. wide, using approved epoxy injection product.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: The owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.

   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Water and Slump: AASHTO T-318 (Microwave Test) and ASTM C 143 (Slump Test); one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix. Verify with unit weight or cylinder weight tests.

4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.

   b. Cast and field cure one set of four standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.

   a. Test one laboratory-cured specimen at 7 days, two at 28-days and hold one cylinder for additional information as required.

   b. A compressive-strength test at 28-days shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.

C. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi .

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

E. Non-Compliant Test Reports: All test reports indicating non-compliance should be e-mail or faxed immediately to all parties on the test report distribution list. Copies shall be on different colored paper.

F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.

END OF SECTION

2. Fiber reinforced Kraft paper, two sheets cemented together with a bituminous material, Polyethylene film not less than .004" thick.
3. Polyethylene film not less than .004" thick.
4. White burlap- polyethylene sheathing.
5. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to approval of the Engineer of Record.

PART 3 - EXECUTION

3.01 INITIAL CURING

A. Initially cure concrete immediately after placement using the following procedures:

1. Fogging: Setup fogging equipment to allow complete coverage of the area to be cured. Maintain relative humidity above the slab at a level to prevent surface drying and accumulation of standing water on the surface. The minimum rate of fog application shall not be less than 10.6 gal./h/sq. Yard. Do not allow the surface to dry or undergo cycles of drying and wetting.
2. Evaporation Retardent: Entrap any bleed water on the concrete surface under a uniform film of a liquid applied evaporation retardant. Apply evaporation retardant after strike off and between different float operations.
3. Provide wind protection screens as required to prevent rapid evaporation of moisture during placement operations.

3.02 FINAL CURING AND PROTECTION

A. Beginning immediately after placement, protect concrete from premature drying, excessively hot and cold temperatures, and mechanical injury. New concrete shall be accomplished by any of the following methods or combinations thereof, subject to approval of the Engineer of Record. Whenever unusual temperature or other conditions occur, the Contractor shall augment the methods described or adapt additional protective measures as directed by the Engineer of Record.

B. Concrete surfaces shall be kept continuously wet by sprinklering or fogging with water, or by material thoroughly saturated with water and kept wet by intermittent hosing. Concrete shall be protected against freezing during the curing process.

C. For reinforced and post-tensioned concrete floor construction for parking structure and for mat construction, final curing and protection shall consist of the following:

1. Ultra Cure single use wet blankets or equal for concrete exposed to the sun, use Ultra Cure Sun. Edges of adjacent sheet shall be overlapped a minimum of four inches and tightly sealed. Remove all air pockets and wrinkles. Cover the entire area of concrete slab including edges. Follow manufacturer's specifications for installation.

D. For reinforced and post tensioned concrete floor construction other than parking structure floors and mat construction, final curing and protections shall consist of the following:

1. Waterproof paper for curing concrete shall consist of two sheets of kraft paper cemented together with bituminous adhesive with fiber reinforcement. Edges of adjacent sheet shall be overlapped several inches and tightly sealed with approved mastic or pressure sensitive tape. Sheeting shall be weighted to maintain close contact with concrete surfaces during entire curing period. Tears or holes in sheeting appearing during this curing period shall be immediately repaired.
2. Plastic sheet materials such as a polyethylene film conforming to ASTM C-171 are acceptable. Sheeting shall not be less than 0.004" thick. Edges of adjacent sheets shall be overlapped several inches and tightly sealed with approved mastic or pressure sensitive tape. Polyethylene shall be clear or white opaque film. Kraft paper coated with

not less than 0.002" thick polyethylene sheeting is acceptable.

3. Curing compounds are acceptable where bond between hardened and fresh concrete is not required. Curing compounds shall conform to specifications for liquid membrane forming compounds for curing concrete, ASTM C-309. Curing compounds shall be applied immediately following last finishing operations. If manufacturer's special finish coatings or wearing surfaces are specified, liquid membrane forming curing and sealing compounds shall be compatible and applied in accordance with the manufacturer's recommendations.
4. Walls, columns, sidewalks, curbs, composite slabs on metal deck and any other concrete work shall be cured by curing compounds as per manufacturer's recommendations.

E. Termination of Curing:

1. Unless otherwise specified, cure reinforced concrete slab and mat construction for a minimum of 7 days provided that the concrete surface temperature is at least 50 degrees.
2. Concrete strength shall meet or exceed 70 percent of design concrete compressive strength required by contract documents before termination of curing measures. In no case shall the length of curing for reinforced concrete slab or mat construction be less than 7 days.
3. Form left in place on walls and columns 72 hours at a temperature over 50 degrees F. shall be considered adequately cured. Wood forms left in place shall be kept moist by sprinklering during hot dry weather. After forms have been removed, apply a curing compound as specified on all concrete surfaces where bonding of hardened and fresh concrete is not required.

F. When the mean daily temperature outdoors is less than 30 degrees F., maintain the temperature of the concrete between 50 degrees F. and 70 degrees F. for the required curing period. When necessary, provide proper and adequate heating system capable of maintaining the required heat without injury due to concentration of heat. Do not use combustion heaters during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases, which contain carbon dioxide.

END OF SECTION

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SECTION 04 20 00- UNIT MASONRY

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. Unit Masonry assemblies consisting of the following:
   1. Concrete Unit Masonry.
   2. Brick Masonry.
   3. Flashing.
   4. Joint reinforcement / masonry wall ties/anchors.

B. Products installed, but not furnished, under this Section include the following:
   1. Steel lintels and shelf angles for unit masonry, furnished under Division 5 Section "Metal Fabrications."
   2. Hollow-metal frames in unit masonry openings, furnished under Division 8 Section "Steel Doors and Frames".

1.3 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops the following net-area compressive strengths (f'm) at 28 days. Determine compressive strength of masonry from net-area compressive strengths of masonry units and mortar types according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

B. Provide unit masonry that develops the following net-area compressive strengths (f'm) at 28 days. Determine compressive strength of masonry by testing masonry prisms according to ASTM C 1314.
   1. For Concrete Unit Masonry: f'm = 1500 psi .

1.5 SUBMITTALS

A. Product Data: For each different masonry unit, accessory, and other manufactured product specified.

B. Shop Drawings: Show fabrication and installation details for the following:
   1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

D. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
   1. Each type of masonry unit required.
      a. Include size-variation data for block, verifying that actual range of sizes falls

within specified tolerances.

b. Include test results, measurements, and calculations establishing net-area compressive strength of masonry units.

2. Mortar complying with property requirements of ASTM C 270.

a. Type S.

3. Grout mixes complying with compressive strength requirements of ASTM C 476. Include description of type and proportions of grout ingredients.

E. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Each type of masonry unit required.

a. Include size-variation data for block, verifying that actual range of sizes falls within specified tolerances.

b. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.

2. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.

3. Each combination of masonry unit type and mortar type. Include statement of net-area compressive strength of masonry units, mortar type, and net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ ASCE 6/TMS 602.

4. Each material and grade indicated for reinforcing bars.

5. Each type and size of joint reinforcement.

6. Each type and size of anchor, tie, and metal accessory.

F. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1093 to conduct the testing indicated, as documented according to ASTM E 548.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

1. Protect Type I concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementituous materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread on ground and over wall surface.

2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial

shade and wind breaks and use cooled materials as required.

1. When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

F. Where hand laid masonry which will be laid adjacent to precast masonry units, the joint pattern must coincide.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. General: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.

2. Provide square-edged units for outside corners.

B. Concrete Masonry Units: ASTM C 90 and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.

2. Weight Classification: Normal weight.

3. Provide Type I, moisture-controlled units.

4. Size (Width): Manufactured to the following dimensions:

a. Provide nominal 16" x 10" x 8".

b. Use 8" x 8" scored pattern on block walls associated with northwest tower as indicated on drawings.

5. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

C. Face Brick: ASTM C 216 and as follows:

1. Grade and Unit Compressive Strength: Provide units with grade and minimum average net-area compressive strength indicated below:

a. Grade: SW

b. 3000 psi

c. Not less than the unit compressive strengths required to produce clay masonry construction compressive strength indicated.

2. Initial Rate of Absorption: Between 5 and 20 g/30 sq.in. per minute when tested per ASTM C 67.

3. Size: Bricks manufactured to the following actual dimensions within tolerances specified in ASTM C216:

a. Utility: 3-1/2 to 3-5/8 inches thick by 3-1/2 to 3-5/8 inches high by 11-1/2 to 11-5/8 inches long.

4. Application: Use where brick is exposed, unless otherwise indicated

5. Provide brick to match existing.

2.2 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.

D. Mortar Cement: ASTM C 1329.

E. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

F. Aggregate for Grout: ASTM C 404.

G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

H. Refractory Mortar Mix: Ground fireclay or non-water-soluble, calcium aluminate, refractory mortar; complying with ASTM C 199, medium duty; or an equivalent product acceptable to authorities having jurisdiction.

I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by the manufacturer for use in masonry mortar of composition indicated.

J. Pigment for Colored Mortar: Iron or chromium oxides with demonstrated stability and colorfastness.

1. Color: as required to match architect's color sample.

K. Water: Potable.

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

M. Products: Subject to compliance with requirements, provide on of the following:

1. Mortar Cement:
   a. Magnolia Superbond Mortar Cement; Blue Circle Cement.
   b. Lafarge Mortar Cement; Lafarge Corporation.

2. Cold-Weather Admixture:
   a. Accelguard 80; Euclid Chemical Co.
   b. Morseled; W. R. Grace & Co., Construction Products Division.
   c. Trimix-NCA; Sonneborn, Div. of ChemRex, Inc.

N. Water-Repellent Admixture: Liquid water-repellant mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.

2.3 REINFORCING STEEL

A. Uncoated Steel Reinforcing Bars: ASTM A 615, Grade 60.

2.4 MASONRY JOINT REINFORCEMENT

A. General: ASTM A 951 and as follows:

1. Hot-dip galvanized, carbon-steel wire for all walls.

2. Wire Size for Side Rods: W1.7 diameter.

3. Wire Size for Cross Rods: W1.7 diameter.

4. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units where indicated.

B. For single-wythe masonry, provide either ladder or truss type with single pair of side rods and cross rods spaced not more than 16 inches o.c.

C. For multi-wythe masonry, provide type as follows:

1. Adjustable (2-piece) tab design with continuous diagonal cross rods spaced not more than 16 inches o.c. with side rods spaced for embedment within each face shell of back-up wythe and with separate adjustable ties engaging the cross ties and extended to engage the outer wythe by at least 1-1/2 inches and spaced not more than 16 inches o.c.

a. Use where facing wythe is of different material than back-up wythe.

2.5 TIES AND ANCHORS, GENERAL

A. General: Provide ties and anchors, specified in subsequent articles, made from materials that comply with this Article, unless otherwise indicated.

B. Mill Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 641, Class 1 coating.

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

2.6 RIGID ANCHORS

A. General: Fabricate from steel bars as follows:

1. 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins.

2. Finish: Hot-dip galvanized to comply with ASTM A 153.

2.7 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron inserts of type and size indicated.

B. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:

1. Headed bolts.
2. Non headed bolts, bent in manner indicated.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Division 7 Section "Sheet Metal Flashing and Trim".

2.8 ADJUSTABLE ANCHORS FOR CONNECTING TO STRUCTURAL FRAME

A. General: Provide 2-piece assemblies as described below, allowing vertical or horizontal differential movement between wall and frame parallel to plane of wall but resisting tension and compression forces perpendicular to it.

1. For anchorage to steel framing, provide manufacturer's standard anchors with crimped 1/4 -inch diameter wire anchor section for welding to steel and triangular-shaped wire tie section sized to extend within 1 inch of masonry face and as follows:

a. Wire diameter: 0.1875 inch.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

1. Styrene-Butadiene-Rubber Compound: ASTM D 2000, Designation M2AA-805.
2. PVC; ASTM D 2287, Type PVC-65406.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells or as indicated on drawings. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication.

1. Provide units with either two loops or four loops as needed for number of bars indicated.

2.10 FLASHINGS

A. Rubberized asphalt, through-wall flashing:

1. Flexible Flashing: Sando-Seal Self-Adhering Flashing: 40 mil thick membrane comprised of 32 mils of highly adhesive rubberized asphalt integrally bonded to an 8 mil high density, cross laminated polyethylene film.
2. Primer: Manufacturer's special primer formulated to prepare surfaces for self-adhering flashing.

B. Wall Flashing Accessories:

1. Surface Conditioner: Water-based type; for substrate preparation.
2. Termination Mastic: Rubberized aphalt type.
3. Drip Edge: Stainless steel, ASTM A 666, Type 304, Soft temper; 26 gage thickness with 3/16 inch hemmed edge.
4. Cavity wall drainage material: "Mortar Net" Soft manufactured from 200 denier recycled polyester; 90% open mesh with dovetail cut.

2.11 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of 1/2-cup dry measure tetrasodium polyphosphate and 1/2-cup dry measure laundry detergent dissolved in 1 gal. of water.

2.12 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Add cold-weather admixture (if used) at the same rate for all mortar, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270 Proportion Specification.

D. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification.

1. Extend-Life Mortar for Unit Masonry: Mortar complying with ASTM C 1142 may be used instead of mortar specified above, at Contractor's option.
2. Limit cementitious materials in mortar to portland cement, mortar cement and lime.
3. Limit cementitious materials in mortar for exterior masonry to portland cement, mortar cement, and lime.
4. For masonry below grade, in contact with earth, exterior walls and where indicated, use Type S.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
   a. Compressive strength shall be 2000 psi minimum at 28-days.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

2.13 SOURCE QUALITY CONTROL

A. Owner will engage a qualified independent testing agency to perform source quality-control testing indicated below:

1. Payment for these services will be made by Owner from the Inspection and Testing Allowance.
2. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

B. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

3.2 INSTALLATION, GENERAL

A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.

B. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 CONSTRUCTION TOLERANCES

A. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:

B. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

C. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, nor 1/2 inch maximum.

D. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

E. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

F. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

1. As indicated on Drawings.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners.

D. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

F. Fill space between hollow-metal frames and masonry solidly with mortar, unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.

2. At fire-rated partitions, install firestopping in joint between top of partition and underside of structure above to comply with Division 7 Section "Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow masonry units as follows:

1. With full mortar coverage on horizontal and vertical face shells.

2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.

3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.

3.6 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.

2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.

3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.7 MASONRY JOINT REINFORCEMENT

A. General: Provide continuous masonry joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8-inch on exterior side of walls, 1/2-inch elsewhere. Lap reinforcement minimum of 6-inches.

1. Space reinforcement not more than 16 inches o.c.

2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.

3. Space reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.

a. Reinforcement above is in addition to continuous reinforcement.

b. Do not cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated. Wrap bars as noted on drawings.

c. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as director by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joints in unit masonry where indicated. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Install preformed control-joint gaskets designed to fit standard sash block.

3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 16 inches for block-size units are shown without structural steel or other supporting lintels.

1. Provide built-in-place masonry lintels. Use specifically formed bond beam units with reinforcing bars placed as indicated and filled with coarse grout. Temporarily support built-in-place lintel until cured.

C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.10 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.

1. Construct formwork to conform to shape, line, and dimensions shown. Make it sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements of ACE 530.1 and ASCE.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.

1. Comply with requirements of ACI 530.1 and ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.11 FIELD QUALITY CONTROL

A. Owner will engage a qualified independent testing agency to perform field quality-control testing indicated below:

1. Payment of these services will be made by Design/Builder.

2. Retesting of materials failing to meet specified requirements shall be done at the Contractor's expense.

B. Testing Frequency: Tests and Evaluations listed in the Article will be performed during construction for each 5000 sq.ft. of wall area or portion thereof.

C. Mortar properties will be tested per ASTM C 780.

D. Grout will be sampled and tested for compressive strength per ASTM C 1019.

E. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
4. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.

3.13 MASONRY WASTE DISPOSAL

A. Recycling: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove excess, clean masonry waste and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL

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 structural steel.

B. This Section includes structural steel and architecturally exposed structural steel.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Quality Control" for independent testing agency procedures and administrative requirements.

2. Division 5 Section "Metal Fabrications" for loose steel bearing plates and miscellaneous steel framing.

3. Division 9 Section "Painting" for surface preparation and priming requirements.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. Shop Drawings detailing fabrication of structural steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.

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

E. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.

1. Structural steel, including chemical and physical properties.

2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.

3. Shear stud connectors.

4. Shop primers.

5. Nonmetallic, shrinkage resistant grout.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

1. Fabricator must conform to one of the following requirements:

a. AISC –Certified Plant Category Cbd: complex steel building structures.

b. Fabricator shall be registered with and approved by authorities having jurisdiction.

c. Testing and inspection of structural steel fabrication shall be provided as indicated in Source Quality Control.

C. 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".

4. AISC's "Code for Standard Practice for Steel Buildings and Bridges".

a. Sections 3.1, 3.4, 3.5 and 4.2 are specifically excluded from this project.

D. 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 re-certification.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.

B. 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.

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

1.6 SEQUENCING

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel Shapes: ASTM A992.

1. Channels, Plates, and Angles: ASTM A36.

a. Plates exceeding 2 inches in thickness shall be subject to the following additional requirements.

1) Charpy V-Notch testing shall meet a minimum average value of 20 ft-lbs absorbed energy at +70°F in accordance with ASTM A673, frequency P, piece testing.

B. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B.

C. Steel Pipe ASTM A501 or ASTM A 53, Type S, Grade B.

1. Weight Class: as shown on the drawings.

2. Finish: Galvanized.

D. Shear Connectors: ASTM A 108, Grade 1015 through 1020, headed-stud type, cold-finished carbon steel, AWS D1.1, Type B.

E. Anchor Rods, Bolts, Nuts, and Washers: As follows:

1. Unheaded Rods: ASTM A 36 or ASTM A 572, Grade 50.

2. Headed Bolts: ASTM A 307, Grade A; carbon-steel, hex-head bolts; and carbon-steel nuts.

3. Washers: ASTM A 36.

4. Washers at Oversized Round Holes: ASTM A 36 steel plate of thickness as indicated on the drawings.

F. Nonhigh-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A; carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Plain, uncoated.

2. Finish: Hot-dipped zinc-coating, ASTM A153, Class C.

G. 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.

1. Finish: Plain, uncoated.

2. Tension-Control Bolts: ASTM F 1852.

H. Welding Electrodes: E70 electrodes complying with AWS requirements.

1. Welding electrodes to be used at complete penetration groove welds shall be subject to the following additional requirements as determined by AWS classification or manufacturer certification.

a. Charpy V-Notch testing shall meet a minimum average value of 20 ft-lbs absorbed energy at -20°F and 40 ft-lbs absorbed energy at +70°F.

b. Yield Strength: 58 ksi minimum.

c. Tensile Strength: 70 ksi minimum.

d. Elongation: 22 percent.

e. Hydrogen Level: H16 in accordance with AWS A4.3.

2.2 PRIMER

A. Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements of FS TT-P-664.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

2.3 FABRICATION

A. 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. Camber structural steel members where indicated.

2. Identify high-strength structural steel according to ASTM A 6 and maintain markings until steel has been erected.

3. Mark and match-mark materials for field assembly.

4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.

5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.

6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

B. Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.

1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.

2. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.

C. Splicing: Splice members only where indicated.

1. Splices in ASTM A 6 Group 3 shapes with flanges thicker than 1-1/2 inches and ASTM A6 Group 4 and Group 5 shapes are subject to the following additional requirements:

a. All weld tabs and backing bars shall be removed, the root pass area shall be backgouged after backing bar removal, inspected using magnetic particle testing and backwelded until flush or with slight reinforcement. The surface shall then be ground

smooth, to a surface roughness not to exceed 250 microinches. Notches and gouges shall be repaired to the requirements of AWS D1.1, Section 5.15.4.4.

b. All weld access holes required to facilitate groove welding operations shall be as indicated on the drawings.

c. A preheat temperature of not less than 350°F shall be applied prior to making groove-weld splices.

D. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded.

2. ASTM A 6 Group 3 shapes with flanges thicker than 1-1/2 inches and ASTM A 6 Group 4 and Group 5 shapes shall be subject to the following additional requirement:

a. Thermally cut surfaces of beams copes and weld access holes shall be ground to bright metal and inspected by either magnetic particle or dye penetrant methods prior to deposition of splice welds.

b. A preheat temperature of not less than 150°F shall be applied prior to thermal cutting.

E. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's printed instructions.

G. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.

1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

2.4 SHOP CONNECTIONS

A. Shop install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

B. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. All high strength bolts shall be tightened by one of the RCSC approved methods to the minimum pretension for fully-tightened bolts as specified by RCSC

a. Connections indicated on the drawings as slip-critical (SC) shall have the faying surfaces prepared in accordance with RCSC.

C. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch and larger. Grind flush butt welds. Dress exposed welds.

3. Complete penetration groove welds shall have all weld tabs and backing bars removed, the root pass area backgouged after backing bar removal, inspection using magnetic particle

testing, and backwelding until flush or with slight reinforcement. The surface shall then be ground smooth, to a surface roughness not to exceed 250 microinches. Notches and gouges shall be repaired to the requirements of AWS D 1.1, Section 5.15.4.4. All weld access holes required to facilitate groove welding operations shall be as indicated on the drawings.

2.5 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits.

1. SSPC-SP 3 "Power Tool Cleaning."

C. 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. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply 2 coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

2.6 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.

2.7 SOURCE QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
2. Provide testing agency with access to places where structural steel work is being fabricated or produced so required inspection and testing can be accomplished.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

D. Structural steel fabrication will be tested and inspected by an AWS-certified Welding inspector in accordance with the specified requirements.

1. Structural steel fabrication need not be inspected when fabrication is performed by an AISC-certified Category Cbd fabricator or a fabricator registered with and approved by authorities having jurisdiction.

E. Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".

F. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.

1. Liquid Penetrant Inspection: ASTM E 165.

2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T".

4. Ultrasonic Inspection: ASTM E 164.

G. In addition to visual inspection, shop welded shear connectors will be inspected and tested according to requirements of AWS D 1.1 for stud welding and as follows:

1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.

2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.

B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION

A. Set 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.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.

2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

   a. Comply with manufacturer's instructions for proprietary grout materials.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

1. Maintain erection tolerances of architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

E. Splice members only where indicated.

1. Splices in ASTM A 6 Group 3 shapes with flanges thicker than 1-1/2 inches and ASTM A 6 Group 4 and Group 5 shapes are subject to the following additional requirements:

   a. All weld tabs and backing bars shall be removed, the root pass area shall be backgouged after backing bar removal, inspected using magnetic particle testing, and backwelded until flush or with slight reinforcement. The surface shall then be ground smooth to a surface roughness not to exceed 250 micorinches. Notches and gouges shall be repaired to the requirements of AWS D 1.1, Section 5.15.4.4.

   b. All weld access holes required to facilitate groove welding operations shall be as indicated on the drawings.

   c. A preheat temperature of no less than 350°F shall be applied prior to making groove-weld splices.

F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

G. Finish sections thermally cut during erection equal to a sheared appearance.

H. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. Install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

B. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. All high strength bolts shall be tightened by one of the RCSC approved methods to the minimum pretension for fully-tightened bolts as specified by RCSC.

    a. Connections indicated on the Drawings as slip-critical (SC) shall have the faying surfaces prepared in accordance with RCSC.

C. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch and larger. Grind flush butt welds. Dress exposed welds.

3. Complete penetration groove welds shall have all weld tabs and backing bars removed, the root pass area background after backing bar removal, inspection using magnetic particle testing, and backwelding until flush or with slight reinforcement. The surface shall then be ground smooth, to a surface roughness not-to-exceed 250 microinches. Notches and gouges shall be repaired to the requirements of AWS D 1.1, Section 5.15.4.4. All weld access holes required to facilitate groove welding operations shall be as indicated on the drawings.

3.5 FIELD QUALITY CONTROL

A. Contractor will engage an independent testing and inspecting agency to perform field inspections and tests 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 requirements.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. In addition to visual inspection (if required), field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.

1. Liquid Penetrant Inspection: ASTM E 165.

2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."

4. Ultrasonic Inspection: ASTM E 164.

F. In addition to visual inspection, field-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.

2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

3.6 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on structural steel are included in Division 9 Section "Painting."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

END OF SECTION

SECTION 05 15 16 - STEEL WIRE ROPE RAILING ASSEMBLY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specifications apply to work in this Section.

1.2 SUMMARY

A. Steel wire rope guardrails.

1.3 RELATED SECTIONS

A. Section 03 30 00 Cast-in-Place Concrete: Placement of anchors in concrete.

1.4 REFERENCES

A. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.

B. ASTM E 985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners and accessories.

1.6 CODES AND STANDARDS

A. International Building Code "Barriers for Parking Structures", current adopted addition.

B. Post Tensioned Institute, "Specification for seven wire prestressing steel strand for barrier cable application" current addition.

1.7 DELIVERY AND PROTECTION

A. Deliver barrier cables bundled, tagged and marked. Markings shall conform to those on approved shop drawings.

B. Store barrier cables and accessories at the site in such a manner as to prevent damage and accumulation of dirt. Cables shall be clean at time of concrete placement.

PART 2 PRODUCTS

201 MANUFACTURERS

A. Enerpac Precision "Sure-Lock" GRABB-IT system, Dallas, Texas. (Basis of Design).

B. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MATERIALS

A. Strand- seven wire steel strand used for the barrier cables shall conform to ASTM A-416, "Specification for uncoated seven-wire stress relieved strand for prestressed concrete". Strands shall be grade 250 or grade 270. Strands having a diameter of 0.05 or 0.06 plus coating shall be permitted.

B. All strands and anchorages shall be supplied by company currently certified under the PTI

Certified Plant program.

C. Coating- Barrier cables assembly shall have an applied corrosion protective coating made of the following materials:

1. Zinc Galvanizing in compliance with ASTM Specification A 475 Class A, Table 2 coating weight. Coating shall be applied either hot dip, hot dip and post drawings, or electro plating process that ensures the complete zinc coating around each individual wire and strand.

D. Anchorage- Castings and mechanical barrel anchors, which are designed to receive a matching set of wedges for engagement and lock off of the cables, grab-it connectors, intermediate spreaders, end cap assemblies shall be manufactured with a corrosion protective coating.

2.3 PEDESTRIAN CABLE BARRIER REQUIREMENTS

A. Barrier cable sag shall not exceed 1/8 inch in 18 feet or .007 inch per foot clear span. Cable sag is a function of the weight (w) of the cable itself and the spacing (l) of its supports

B. Wedge type anchorage devices shall be back-stressed to a force equal to 80% of the Minimum Tensile Strength (MUTS) of the barrier cable to ensure that all wedges are seated and the proper connection is made.

C. Barrier shall not be less than 42 inches in height measured vertically from the leading edge of the walking /parking surface.

D. Openings in the barrier shall be limited such that a 4-inch diameter sphere cannot pass through any opening(s) up to a height of 34 inches. Above the height of 34 inches, an 8-inch diameter sphere shall not pass through the opening(s).

E. Minimum diameter of the barrier cable shall be ½ inches.

F. Applied loading to barrier cables shall comply with all applicable code requirements but shall be not less than the following:

1. Uniform load of 50 pounds per lineal foot (plf) applied in any direction.

2. Single concentrated load of 200 pounds applied in any directions and at any point along the barrier cable.

G. Deflection of one barrier cable under applied loading in Section 2.03 item F shall not exceed 9 inches. Referring to Section 2.02 Item B, submitted Engineering Calculations shall include deflections calculation and the prestressing force necessary to maintain the specified deflection under load.

2.4 SPECIFICATION COMPLIANCE REQUIREMENTS

A Conformance testing - the adequacy of a strand system shall be confirmed by satisfactory static and dynamic conformance tests shall be submitted by the company supplying the strands and anchorages.

B The company supplying the barrier systems shall provide design calculations by a professional engineer.

C Prestressing steel - certified mill test results and typical stress-strain curves shall be submitted. The typical stress-strain curve shall be obtained by approved standard practices.

PART 3 – EXECUTION

3.1 PLACING OF CABLE BARRIERS

A Pedestrian cable barriers shall be installed in straight-line segments horizontally or on a slope. Cables shall be continuous between termination points. Intermediate splices or connections are not permitted

B At intermediate columns between termination or end anchor columns, pass through hole as required to place cables shall be formed at midsection of the column. Cast a PVC sleeve schedule 40 with a minimium inside diameter 1/4" inch greater than the cable diameter plus coating. Column sleeves shall be burred/chamfered to mitigate barrier cable coating damage.

C At end columns where barrier cables terminate, the stressing end (s) shall have anchors, which are recesses in the column using a pocket former and PVC sleeve. Pocket former(s) shall be recess to a dimension which shall provide clearance for a for the 1 inch cable tail(s) extension after final cut, plus a 1-1/2 inch clear cover over the tail(s). Formed pockets shall be completely filled with non- shrink grout.

D At end columns where barrier cables terminate, alternatively a barrel anchor with an exposed end cap and a PVC sleeve is permitted at the stressing end of the cable.

E Intermediate spacers assemblies consisting of a plate with u-bolts or an intermediate tube shall be provided at mid span between supports when necessary to maintain cable spacing and sag requirements.

F End columns that exhibit inaccessible end conditions, The installation of a grab-it connection and anchor is permitted.

G Protective coating that has been damaged during installations shall be repaired in strict conformance to manufacturer's recommendations.

3.2 STRESSING OF CABLE STRANDS

A Strands shall be stressed up to a minimum of 3000 pound to control cable sag. Following the stressing of the cables, sag deflection shall be measured at each column-to-column span condition. Cable Sag, which exceed the required maximum, provide additional stressing load until the sag deflection requirements are in compliances.

B All fixed end, stressing ends and adjustable anchorages shall be back-stressed to a force equal to 80% of the Minimum Tensile Strength (MUTS) of the barrier cable to ensure that all wedges are seated and the proper connection is made.

C Back-stressing procedure shall be performed after the barrier cable is stressed to initial tensioning force is achieved. When back-stressing against a concrete member a slotted steel plate or other special nosepiece shall be used to prevent damage to the concrete.

D Back-stressing produces visible gripper marks on the barrier strand. Repair all damaged coating.

E Incremental and final stress loads shall be recorded and verified by gauges or other methods. Records shall be neat and orderly and certified by contractor to be accurate

END OF SECTION

SECTION 05 21 00 - STEEL JOIST FRAMING

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. Open web steel joists, with bridging, attached seats and anchors.

B. Loose bearing members, such as plates or angles and anchor bolts for site placement.

C. Supplementary framing for floor and roof openings greater than 18 inches.

1.3 RELATED SECTIONS

A. Section 04 20 00 - Unit Masonry: Embedding anchors for bearing plates.

B. Section 05 12 00 - Structural Steel Framing: Superstructure supporting members.

C. Section 05 31 00 - Steel Decking: Support framing for openings less than 18 inches in decking.

D. Section 05 50 00 - Metal Fabrications: Non-framing steel fabrications attached to joists.

1.4 REFERENCE STANDARDS

A. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2008.

B. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and steel Hardware; 2009.

C. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength; 207b.

D. AWS D1.1/D1.1M Structural Welding Code - Steel; American Welding Society; 2010.

E. SJI (SPEC) - Catalog of Standard Specifications and Load Tables for Steel Joists and Joist Girders; Steel Joist Institute; 2005.

F. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders; Steel Joist Institute; 2006.

G. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use over Hand Cleaned Steel, Type I and Type II; Society for Protective Coatings; 1997 (Ed.2004).

H. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

1.5 SUBMITTALS

A. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spaces, chambers, location s of joists, joist leg extensions, bridging, connections, attachments and recycled content for LEED documentation.

1.6 QUALITY ASSURANCE

A. Perform Work, including that for headers and other supplementary framing, in accordance with SJI Standard Specifications Load Tables and SJI Technical Digest No. 9.

B. Manufacturer Qualifications: Company specializing in performing the work of this section with minimum ten years documented experience.

C. Erector Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

1.7 DELIVERY, STORAGE AND HANDLING

A. Transport, handle, store, and protect products to SJI requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. Open Web Joists: SJI Type K Joists:

1. End bearing of 2-1/2 inches on steel supports.
2. End bearing of 4 inches on masonry supports.
3. Finish: Shop primed.

B. Anchor Bolts, Nuts and Washers: ASTM A 307, hot-dip galvanized per ASTM A 153/A 153M, Class C.

C. Structural Steel for Supplementary Framing and Joist Leg Extensions: ASTM A 36/A 36M.

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

E. Shop and Touch-Up Primer: SSPC-Paint 25, zinc oxide, complying with VOC limitations of authorities having jurisdiction.

2.2 FINISH

A. Shop prime joists.

B. Prepare surfaces to be finished in accordance with SSPC-SP 2.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.2 ERECTION

A. Erect joists with correct bearing on supports.

B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.

C. Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.

D. After joist alignment and installation of framing, field weld joist seals to steel bearing surfaces.

E. Install supplementary framing for roof openings greater than 18 inches.

F. Do not permit erection of decking until joists are braced bridged and secured or until completion of erection and installation of permanent bridging and bracing.

G. Do not field cut or alter structural members without approval of joist manufacturer.

H. After erection, prime damaged shop primer and surfaces not shop primed, except surfaces specified not to be primed.

3.3 TOLERANCES

A. Maximum Variation from Plumb: ¼ inch.

B. Maximum Offset from True Alignment: ¼ inch.

END OF SECTION

SECTION 05 31 00 - STEEL DECKING

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. Roof deck.

B. Supplementary framing for openings up to and including 18 inches.

C. Bearing plates and angles.

1.3 RELATED SECTIONS

A. Section 04 20 00 - Unit Masonry: Embedding anchors for bearing plates.

B. Section 05 21 00 - Steel Joist Framing: Support framing for openings larger than 18 inches.

C. Section 09 90 00 - Painting and Coating: Site applied painting.

1.4 REFERENCE STANDARDS

A. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2008.

B. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2009.

C. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2009a.

D. AWS D1.1/D1.1M Structural Welding Code - Steel; American Welding Society; 2010.

E. AWS D1.3 - Structural Welding Code - Sheet Steel; American Welding Society; 2008.

F. SDI (DM) - Publication No. 31, Design Manual for Composite Decks, Form Decks, Roof Decks;Steel Deck Institute; 2007

G. SSPC-Paint 20 - Zinc-Rich Primers (Type 1, "Inorganic", and Type II, "Organic"); The Society for Protective Coatings; 2002 (Ed.2004).

H. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II; Society for Protective Coatings; 1997 (Ed. 2004).

1.5 SUBMITTALS

A. Shop Drawings: Indicate deck plan, support locations, projections, openings, pertinent details and accessories.

B. Product Data: Provide deck profile characteristics, dimensions, structural properties, finishes, and recycled content for LEED Documentation.

C. Certificates: Certify that products furnished meet or exceed specified requirements.

D. Submit manufacturer's installation instructions.

E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this Section with minimum five years of experience.

1.7 DELIVERY, STORAGE AND HANDLING

A. Cut plastic wrap to encourage ventilation.

B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.1 STEEL DECK

A. Roof Deck: Non-Composite type, fluted steel sheet:
   1. Galvanized Steel Sheet: ASTM A653/A 653M, Structural Steel (SS) Grade 37/255, with G90/Z275 galvanizing coating.
   2. Minimum Metal Thickness, Excluding Finish: 18 gage.
   3. Nominal Height: 1-1/2 inch.
   4. Profile: Fluted; SDI WR.
   5. Formed Sheet Width: 36 inch.
   6. Side Joints: Lapped, mechanically fastened.
   7. End Joints: Lapped, mechanically fastened.

2.2 ACCESSORY MATERIALS

A. Bearing Plates and Angles: ASTM A 36/A 36M steel, galvanized per ASTM A 123/A 123M.

B. Welding Materials: AWS D1.1.

C. Fasteners: Galvanized hardened steel, self tapping.

D. Weld Washers: Mild steel, uncoated, ¾ inch outside diameter, 1/8 inch thick.

E. Shop and Touch-Up Primer: SSPC-Paint 25, zinc oxide, complying with VOC limitations of authorities having jurisdiction.

F. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

G. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

2.3 FABRICATED DECK ACCESSORIES

A. Sheet Metal Deck Accessories: Metal closure strips and cover plates, 22 gage thick sheet steel; of profile and size as indicated; finished same as deck.

B. Roof Drain Pans: 14 gage sheet steel, flat bottom, perpendicular sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.2 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. On concrete and masonry surfaces provide minimum 6 inch bearing.

C. On steel supports provide minimum 3 inch bearing.

D. Fasten deck to steel support members at ends and intermediate supports at 12 inches on center maximum, parallel with the deck flute and at every other transverse flute using welds as indicated in Drawings.

1. Welding; Use fusion welds through weld washers.

E. At male/female side laps fasten at 24 inches on center maximum.

F. Where welding is required, weld deck in accordance with AWS D1.3.

G. At deck openings from 6 inches to 18 inches in size, provide 2 x 2 x ¼ inch steel angle reinforcement. Place angles perpendicular to flutes; extended minimum two flutes beyond each side of opening and fusion weld to deck at each flute.

H. At openings between deck and walls, columns and openings, provide sheet steel closures and angle flashings to close openings.

I. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.

J. Position roof drain pans with flange bearing on top surface of deck. Fasten at each deck flute.

K. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION

SECTION 05 50 00 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK:

A. The extent of miscellaneous metal work is shown on the drawings and include items fabricated from iron and steel shapes, plates, bars, strips, tubes, pipes and castings. Erection of loose items other than angle lintels is included.

B. The types of miscellaneous metal items include, but are not limited to the following:

1. Miscellaneous lintels, angle of various types, beams and plates.
2. Frames fabricated from structural steel shapes and miscellaneous structural shapes, etc.
3. Miscellaneous Steel trim.
4. Galvanized steel plate guards (for exposed vertical piping, conduit, etc).
5. Steel post bumpers.
6. Inserts (except for unit masonry)
7. Touch-up painting.
8. Elevator pit ladders.
9. Steel grates at elevater sump pits.
10. Roof Safety Anchors
11. Metal stair nosings.
12. Security screen in precast above Security Office (deleted if Alternate No. 1 accepted).

C. In these specifications - NO ATTEMPT - has been made to enumerate or describe in detail each item required, but only to indicate principal items and general construction including certain special items.

D. Take special note of structural steel and miscellaneous weldments required for embedment in cast-in-place concrete. See structural drawings.

E. Related work specified elsewhere:

1. Loose hardware for securing precast concrete panels. See Architectural Precast Concrete.
2. Field painting other than prime touch up
3. Masonry anchors and reinforcement: See Unit Masonry.
4. Anchor, bolts, sleeves, clips and hangers needed for installation of plumbing, HVAC and electrical equipment.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: Comply with the provisions of the following codes, standards and specifications, except as otherwise shown and specified.

1. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings," and including the "Commentary of the AISC Specification."
2. AISI "Specification for the Design of Cold-Formed Steel Structural Members".
3. AWS "Code for Welding in Building Construction".

4. ASTM A36 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".

B. AISC Qualification for Welding Work:

1. Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".

2. Submit certification that all welders to be employed in work are AWS qualified.

C. Field Measurements:

1. Take field measurements prior to preparation of shop drawings and fabrication, where possible, to ensure proper fitting of the work. However, do not delay job progress; allow for trimming and fitting wherever the taking of field measurements before fabrication might delay the work.

D. Inserts and Anchorages:

1. Furnish inserts and anchoring devices not furnished under other trade sections which must be set in concrete or built into masonry for the installation of miscellaneous metal work. Provide setting drawings, templates, instructions and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

2. See concrete and masonry, sections of these specifications for installation of inserts and anchorage devices.

E. Shop Assembly:

1. Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

PART 2 - MATERIALS

2.1 STEEL AND IRON:

A. Metal Surfaces, General:

1. For the fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes including zinc coatings.

B. Structural Steel Plates, Shapes and Bars:

1. Structural-Size Shapes and Plates (Except Plates to be Bent of Cold Formed): ASTM A 36.

2. Steel Bars and Bar-Size Shapes: ASTM A 306, Grade 65, or ASTM A 36.

3. Structural Steel Tubing (Hot-Formed, Welded or Seamless): ASTM A 501.

4. Hot-Rolled Carbon Steel Bars (and Bar-Size Shapes): ASTM A 575, grade as selected by the fabricator.

5. Cold-Finished Steel Bars: ASTM A 108, grade as selected by the fabricator.

6. Hot-Rolled Carbon Steel Sheets and Strips: ASTM A 568 and ASTM A 569; pickled and oiled.

7. Cold-Rolled Carbon Steel Sheets: ASTM A 366.

8. Galvanized Carbon Steel Sheets: ASTM A 526, with 2.02 oz. "Commercial" zinc coat complying with ASTM A 525.

9. Cold-Drawn Steel Tubing: ASTM A 512, sunk drawn, butt welded, cold-finished and stress-relieved.

10. Gray Iron Castings: ASTM A 48, Class 30.

11. Malleable Iron Castings: ASTM A 47, grade as selected.

12. Steel Pipe: ASTM A 53: type as selected: Grade A: black finish unless galvanizing is required: heavy weight (Schedule 40), unless otherwise shown or specified.

13. Provide stainless steel material of similar material properties to those otherwise required for those items on the drawings as stainless steel.

14. Woven wire mesh: 10 ga. Steel woven mesh (plain weave), 1-1/2" square openings.

2.2 ANCHORS:

A. Threaded-Type Concrete Inserts: Galvanized ferrous castings, internally threaded to receive 3/4" diameter machine bolts (or as noted on drawings); either malleable iron complying with ASTM A 47 or cast steel complying with ASTM A 27; hot-dip galvanized in compliance with ASTM A 153.

B. Wedge-Type Concrete Inserts: Galvanized box-type ferrous castings, designed to accept 3/4" diameter bolts (or as noted on drawings) having special wedge-shaped heads; either malleable iron complying with ASTM A 47 or cast steel complying with ASTM A 27; hot-dip galvanized in compliance with ASTM A 153.

C. Provide carbon steel bolts having special wedge-shaped heads, nuts, washers and shims; all galvanized in compliance with ASTM A 153.

D. Slotted-Type Concrete Inserts: Galvanized 1/8" thick pressed steel plate complying with ASTM A 283; box-type welded construction with slot designed to receive 3/4" diameter square head bolt and with knockout cover; hot-dip galvanized in compliance with ASTM A 386.

E. Masonry Anchorage Devices: Expansion shields complying with FS FF-S-325, as follows:

1. Provide lead expansion shields for machine screws and bolts 1/4" and smaller; head-out embedded nut type, single unit class, Group 1, Type 1, Class 1.

2. Provide lead expansion shields for machine screws and bolts larger than 1/4" in size; head-out embedded nut type, multiple unit class, Group 1, Type 1, Class 2.

2.3 FASTENERS:

A. General: Provide zinc-coated fasteners, with galvanizing complying with ASTM A 153, for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required for the installation of miscellaneous metal items.

2.4 PAINT:

A. Zinc Chromate Primer: FS TT-P-645 or similar compatible with the required finish coats of paint. Coordinate selection of metal primer with finish paint requirements specified in Division 9 of these specifications.

B. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel, complying with Military specifications Mil-P-21035 (Ships). Materials shall be as manufactured by ZRC Chemical Products Co., Quincy, Mass. Material shall be applied in accordance with manufacturer's instructions.

2.5 FABRICATION, GENERAL WORKMANSHIP:

A. Use materials of the size and thicknesses shown, or if not shown, of the required size and thickness to produce adequate strength and durability in the finished product for the intended

use. Work to the dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use the type of materials shown or specified for the various components of work.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32" unless otherwise shown. Form bent-metal corner to the smallest radius possible without causing grain separation or otherwise impairing the work.

C. Weld corners and seams continuously and in accordance with the recommendations of AWS. Grind exposed welds smooth and flush, to match and blend with adjoining surfaces.

D. Form exposed connections with hairline joints which are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type shown, or if not shown, use Phillips flathead (countersunk) screws or bolts.

E. Provide for anchorage of the type shown, coordinated with the supporting structure and the progress schedule. Fabricate and space anchoring devices as shown and as required to provide adequate sup- port for the intended use of the work.

F. Cut, reinforce, drill and tap miscellaneous metal work as may be required to receive finish hardware and similar items of work.

G. Use hot-rolled steel bars for work fabricated from bar stock, unless work is shown or specified to be fabricated from cold-finished or cold-rolled stock.

H. Galvanizing: Provide a zinc coating for those items shown on the drawings where specified to be galvanized using the hot-dip process after fabrication.

1. Comply with ASTM A 153 for galvanizing of iron and steel hardware.
2. Comply with ASTM A 123 for galvanizing of rolled, pressed and forged steel shapes, plates, bars and strip 1/8" thick and heavier.
3. Comply with ASTM A 386 for galvanizing of assembled steel.

2.6 SHOP PAINTING:

A. Shop paint all miscellaneous metal work, except those members or portions of members to be embedded in concrete or masonry, surfaces and edges to be field welded and galvanized surfaces, unless otherwise specified.

B. Remove scale, rust and other deleterious materials before the shop coat of paint is applied. Clean off heavy rust and loose mill scale in accordance with SSPC SP-2 "Hand Tool Cleaning," or SSPC SP-7 "Brush-Off Blast Cleaning". Remove oil, grease and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning".

C. Apply one shop coat of metal primer paint to fabricated metal items, except apply two coats of paint to surfaces which are inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

D. Immediately after surface preparation, brush or spray on metal primer paint, applied in accordance with the manufacturer's instructions and at a rate to provide a uniform dry film thickness of 2.0 mils for each coat. Use painting methods which will result in full coverage of joints, corners, edges and all exposed surfaces.

2.7 MISCELLANEOUS LINTELS, ANGLES, BEAMS AND PLATES:

A. Provide miscellaneous lintels, angles, beams and plates where shown and noted on the drawings. Lintels shall have a 6" bearing at each end unless otherwise shown. Weld bolt or rivet members together where so indicated, to form a complete assembly. Set beams on plates as indicated. Where angles are attached to concrete or masonry with bolts and adjustable inserts, provide holes of proper size and spacing in vertical leg of shelf angles.

2.8 FRAMES AND BRACKETS:

A. Provide all structural shape steel frames and brackets, and connect frames to other work as indicated. Frames and brackets shall be of sizes and shapes shown; made true and square, out of wind, with corners braced and provided with strap anchors for building into concrete or masonry. When required, provide frames with bar stops of sizes shown, grind all exposed welds smooth. Fit door frames with temporary spreader bards at open end. Prepare frames to receive hardware where necessary.

B. Where steel lintel members occur in combination with head of door frames, adequately weld the lintel to the head.

2.9 PIPE BUMBER POSTS:

A. Provide and install where shown and noted on the drawings, high strength steel pipe bumper posts, 3'-6" high, unless otherwise shown. Provide base plate sleeves and anchor bolts where detailed on drawings.

2.10 PLATE GUARDS:

A. Furnish and install galvanized steel shapes, plates, angles, as guards for all vertical piping, in parking deck areas as generally detailed and as required and/or as shown.

B. Fabrication shall be rolled steel shapes, plate sizes and thickness as shown, and exposed corners rounded by grinding.

C. Anchorage to concrete and/or masonry with strap anchors welded to backs. Anchors for concrete shall be l-l/2" x l/4" and masonry l-l/2" x l/8"; 3'-0" o.c. spacing for continuous pieces, hooked ends, fitting jointing; minimum 8" long for masonry coursing. All other items shall be bolted with expansion shields and/or toggle bolts, use machine bolts for steel.

2.11 MISCELLANEOUS FRAMING AND SUPPORTS:

A. Provide miscellaneous steel framing and supports which are as required to complete the work.

B. Fabricate miscellaneous units to the sizes, shapes and profiles shown or, if not shown, of the required dimensions to receive adjacent other work to be retained by the framing. Except as otherwise shown, fabricate from structural steel shapes, plates and steel bars, of all welded construction. Use mitered corners, welded brackets, splice plates and a minimum number of joints for field connection. Cut, drill and tap units to receive hardware and similar items to be anchored to the work.

C. Equip units with integrally welded anchor straps for casting into poured concrete or building into masonry wherever possible. Furnish inserts if units must be installed after concrete is poured. (See concrete sections for installation of inserts.) Except as otherwise shown, space anchors 2'-0" o.c., and provide minimum anchor units of 1-1/4" x 1-1/4" x 8" steel straps. Galvanize miscellaneous frames and supports wherever indicated.

2.12 MISCELLANEOUS STEEL TRIM:

A. Provide shapes and sizes as required for the profiles shown. Except as otherwise noted, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fitting and anchorages as required for coordination of assembly and installation with other work. Galvanize miscellaneous steel trim wherever indicated.

2.13 INSTALLATION:

A. Anchorages:

1. Furnish setting drawings, diagrams, templates, instructions and directions for the installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate the delivery of such items to the project site.

B. Fastening to In-Place Construction:

1. Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, and other connectors as required.

C. Cutting, Fitting and Placement:

1. Perform all cutting, drilling and fitting required for the installation of the miscellaneous metal items. Set the work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry of similar construction.

2. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D. Field Welding:

1. Comply with AWS Code for the procedures of manual shielded metal arc welding, the appearance and quality of welds made, and the methods used in correcting welding work.

E. Touch-Up Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of the shop paint, and paint all exposed areas with the same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

2.14 SUBMITTALS:

A. Manufacturer's Data, Miscellaneous Metal:

1. For information only, submit two copies of manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions for products to be used in the fabrication of miscellaneous metal work, including paint products. Indicate by transmittal that copy of instructions has been distributed to the Installer.

2. Shop Drawings, Miscellaneous Metal:

Submit shop drawings in accordance with the requirements in the Supplementary Conditions for the fabrications and erection of all assemblies of miscellaneous metal work, which are not completely shown by the manufacturer's data sheets.

Include plans and elevations at not less than 1" to 1'-0" scale, and include details of sections and connections at not less than 3" to 1'-0" scale. Show anchorage and accessory items.

3. Manufacturer's Data, Miscellaneous Metal:

For information only, submit two (2) copies of manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions for products to be used in the fabrication of miscellaneous metal work, including paint products. Indicate by transmittal that copy of instructions had been distributed to the Installer.

2.15 STEEL LADDERS

A. General: Fabricate ladders for locations shown, with dimensions, spacings, details, and anchorages as indicated.

1. Comply with ANSI A14.3, unless otherwise indicated.

2. For elevator pit ladders, comply with ASME A17.1.

B. Siderails: Continuous, 1/2 -by- 2-1/2-inch (12-by-64-mm) steel flat bars with eased edges, spaced 18 inches (457 mm) apart.

C. Bar Rungs: ¾-inch (19 mm) diameter steel bars, spaced 12 inches (300 mm) o.c.

D. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.

E. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.

F. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granuels set in epoxy-resin adhesive or by using a type of manufacturered rung filled with aluminum-oxide grout.

2.16 STEEL CANTS

A. Provide steel cants fabricated from bent steel plate of size and shape as indicated.

B. Weld to steel frames and ground smooth.

2.17 ROOF SAFETY ANCHORS

A. Provide epoxy adhered safety anchors as shown and detailed on drawings.

B. Manufacturer:

1. Pro-Bell Model PBE78-S.

2. Approved equal.

2.18 METAL STAIR NOSINGS

A. Fabricate units in sizes and configurations indicated and in length necessary to accurately fit openings and conditions. Provide extruded aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide or a combination of both, in an epoxy binder.

1. Provide ribbed units with an abrasive filler strips projection 1/16 inch above aluminum

extrusion.

B. Configurations: Provide units in teh following configurations, unless otherwise indicated:

1. Nosings: Units, 3 inches wide for casting into metal pan stairs. Wooster Model 231-BF (Basis of Design).

C. Provide anchors for embsdding units in concrete, as standard for manufacturer.

D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Safety Treads, Inc.

2. Safe-T-Metal Co.

3. Wooster Products, Inc.

4. Approved equal.

2.19 SECURITY SCREEN IN PRECAST ABOVE SECURITY OFFICE (Deleted if Alternate No. 1 accepted)

A. Provide and install a complete security screen infill system in precast openings above security office. One (1) panel to be operable (and lockable) for Owner access to Security Office Roof.

B. Tube Framing: Provide 1-1/2" sq.steel tube framing system-welded.

1. Flat and formed sheets and plates: ASTM B209.

2. Provide wall thickness and good engineering practice to comply with requirements.

C. Finish: All steel framing and subframing to be galvanized and powder coated: Black.

D. Woven Mesh Infill:

1. Galvanized woven (inter crimp) wire mesh in 2" x 2" pattern.

2. Finish: All mesh to be powder-coated: black.

PART 3 - EXECUTION (not used).

END OF SECTION+++-

SECTION 05 52 00 - METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Galvanized steel pipe and stainless steel tube handrails in stair/elevators.
2. Galvanized steel pipe and tube handrails associated with site walls and stairs.
3. Aluminum Railings in precast wall panels.

1.3 PERFORMANCE REQUIREMENTS

A. General: In engineering handrails and railings to withstand structural loads indicated, determine allowable design working stresses of handrail and railing materials based on the following:

1. Stainless Steel: ASCE 8, "Specification for the Design of Cold-Formed Stainless Steel Structural Members."
2. Structural Steel: AISC S335, "Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary."
3. Cold-Formed Structural Steel: AISI SG-673, Part I, "Specification for the Design of Cold-Formed Steel Structural Members."

B. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for handrails, railings, anchors, and connections:

1. Top Rail of Guards: Capable of withstanding the following loads applied as indicated:
   a. Concentrated load of 200 lbf applied at any point and in any direction.
   b. Uniform load of 50 lbf/ft. applied horizontally and concurrently with uniform load of 100 lbf/ft. applied vertically downward.
   c. Concentrated and uniform loads above need not be assumed to act concurrently.
2. Handrails Not Serving As Top Rails: Capable of withstanding the following loads applied as indicated:
   a. Concentrated load of 200 lbf applied at any point and in any direction.
   b. Uniform load of 50 lbf/ft. applied in any direction.
   c. Concentrated and uniform loads above need not be assumed to act concurrently.
3. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf applied to 1 sq. ft. at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.
   a. Load above need not be assumed to act concurrently with loads on top rails in determining stress on guard.

C. Thermal Movements: Provide handrails and railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F ambient;180 deg F, material surfaces.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

A. Shop Drawings: Show fabrication and installation of handrails and railings. Include plans, elevations, sections, component details, and attachments to other Work.

B. Samples for Initial Selection: Short sections of railing or flat, sheet metal samples showing available mechanical finishes.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of handrail and railing through one source from a single manufacturer.

1.6 STORAGE

A. Store handrails and railings in a dry, well-ventilated, weathertight place.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify handrail and railing dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating handrails and railings without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate installation of anchorages for handrails and railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.9 SCHEDULING

A. Schedule installation so handrails and railings are mounted only on completed walls. Do not support temporarily by any means that does not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS

A. General: Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units.

B. Steel and Iron: Provide steel and iron in the form indicated, complying with the following requirements:

1. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:

a. Galvanized finish for exterior installations and where indicated.
b. Type F, or Type S, Grade A, standard weight (Schedule 40), unless another grade and weight are required by structural loads.

2. Steel Tubing: Cold-formed steel tubing, ASTM A 500, Grade A, unless another grade is required by structural loads.

3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Stainless Steel Handrail: 304 or 316 stainless steel with #6 polish finish.

D. Woven (intercrimp) Mesh Infill: Galvanized woven (intercrimp) wire mesh in 2" x 4" square pattern.

E. Aluminum: Commercially pure alloys of proper types to receive approved matching anodized finish defined, of proper temper for the conditions involved; extrusions not less than .125" thick, sheet .0625" thick.

2.2 WELDING MATERIALS, FASTENERS, AND ANCHORS

A. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

2.3 PAINT

A. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated, and complying with SSPC-Paint 5.

2.4 FABRICATION

A. General: Fabricate handrails and railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble handrails and railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Form changes in direction of railing members as follows:

1. As detailed.

D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed

surfaces of handrail and railing components.

E. Welded Connections: Fabricate handrails and railings for connecting members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose. Weld connections continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

F. Nonwelded Connections: Fabricate handrails and railings by connecting members with concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.

H. Provide inserts and other anchorage devices for connecting handrails and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.

I. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

J. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.

K. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.

L. Fabricate joints that will be exposed to weather in a watertight manner.

M. Close exposed ends of handrail and railing members with prefabricated end fittings.

2.5 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of handrails and railings.

2.6 STEEL FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123, for galvanizing steel and iron products.

B. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. For galvanized handrails and railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

D. Preparation for Shop Priming: After galvanizing, thoroughly clean handrails and railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.

E. Appearance of finish work: Minor variations of abutting or adjacent pieces are acceptable provided that they are kept to a minimum in appearance and texture. Care should be taken during the welding and galvanizing process at all welded joints. Build up of galvanizing at these locations will require grinding and cold galvanizing touch up maintain appearance of joints.

2.7 ALUMINUM FINISH

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear Anodic coating not less than 0.7 mils (0.018) thick.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required to install handrails and railings. Set handrails and railings accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.

1. Do not weld, cut, or abrade surfaces of handrail and railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

3. Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Adjust handrails and railings before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing handrails and railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.3 CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

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

3.4 PROTECTION

A. Protect finishes of handrails and railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 07 18 00 - TRAFFIC COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes traffic coatings for the following applications:

1. Vehicular traffic over Mechanical, Electrical, Storage and Elevator Control Room as indicated on drawings.
2. Vehicular traffic (general areas) as indicated on drawings.
3. Areas to receive traffic coatings are also referenced as T.B.WP. (Traffic Bearing Waterproofing) on drawings.

1.3 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Show extent of each traffic coating. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions. Include layout of traffic striping and markings.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors, textures, and patterns available for each type of product indicated.

D. Material Certificates: Signed by manufacturer certifying that traffic coatings comply with requirements, based on comprehensive testing of current product formulations within the last three years.

E. Maintenance Data: To include in maintenance manuals specified in Division 1. Identify substrates and types of traffic coatings applied. Include recommendations for periodic inspections, cleaning, care, maintenance, and repair of traffic coatings.

1.4 QUALITY ASSURANCE

A. Installer (Applicator) Qualifications: An applicator licensed by the manufacturer who has specialized in installing work similar in material, design, and extent to that indicated for this Project.

B. Source Limitations: As follows:

1. Use traffic coatings of a single manufacturer.
2. Obtain primary traffic coating materials, including primers, from traffic coating manufacturer. Obtain secondary materials including aggregates, sheet flashings, joint sealants, and substrate repair materials of type and from source recommended by traffic coating manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers with seals unbroken and bearing manufacturer's labels showing the following information:

1. Manufacturer's brand name.
2. Type of material.

3. Directions for storage.
4. Date of manufacture and shelf life.
5. Lot or batch number.
6. Mixing and application instructions.
7. Color.

B. Store materials in a clean, dry location protected from exposure to direct sunlight. In storage areas, maintain environmental conditions within range recommended in writing by manufacturer.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.

1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of the substrate.

1.7 WARRANTY (GENERAL AREAS)

A. Furnish to the Owner with a written total responsibility Joint and Several Guarantee, detailing the responsibilities of the manufacturer and applicator with regard to warranty requirements (Joint and Several), as outlined in the Manufacturer's Licensing/ Certification document (a copy of the Licensing/Certification Agreement must be submitted). The guarantee provides that the system will be free of defects. Water penetration and chemical damage related to design, material deficiency, or workmanship, consisting of:

1. Surface crazing or other weathering deficiency.
2. Abrasion or tear failure resulting from traffic use.
3. Defective installation.

B. With the bid submittal, provide Engineer/Architect with a sample of the final joint and several warranty and a copy (as previously noted) of the manufacturers' licensing/ certification agreement, detailing the joint responsibilities of the manufacturer and applicator with regard to warranty claim resolution.

C. If the concrete surface shows any of the defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.

D. The warranty period shall be a five (5) year Joint and several warranty commencing with the date of acceptance of work by the Owner, executed by the Manufacturer and Applicator.

E. Perform repair necessary under this warranty at no cost to the Owner.

1. Vandalism, abrasive maintenance equipment, truck traffic and construction traffic are not normal traffic use and are exempted from the warranty. Also any subsequent floor cracking in excess of 1/16" width is reason for exemption from warranty.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General

1. Liquid Waterproofing: A complete system of compatible materials design to create a seamless waterproof membrane when applied on the type of deck indicated and complying with ASTM C957.

B. System Type

1. System for vehicular traffic deck:

   a. 0.64-mm (25-mil) polyurethane base coat, a 0.31-mm (30-mil) intermediate coat with approved silica sand distributed at 48 kg per 10 square meters (100 lbs. Per 100 square feet), and a 0.31-mm (12-mil) polyurethane topcoat. All mil thickness requirements are dry mils exclusive of aggregate.

2. Manufacturers

   a. Sonneborn "Sonoguard".

   b. Neogard Division of Jones-Blair "Auto-Gard II".

   c. Lym Tal International, Inc. "IsoFlex 750 U Traffic Coating".

   d. Pecora Corporation "Pecora-Deck 800-V".

   e. Carlisle Coatings and Waterproofings "CCW-5123-HD".

   f. Tremco "Vulkem 350/345/346".

C. System Components

1. Primer applied to a dry film thickness of 0.08 mm (3 mils) at a rate of 9.8 m^2/ liter (400 sq.ft. / Gallon).

2. Elastomeric flashing applied to a dry film thickness of 0.51 or 0.76 mm (20 or 30 mils) over the extending 50 mm (2 inches) on each side of cracks, control joints and cold joints to be coated.

3. 1.52-mm (60-mil) elastomeric sheet for flashing isolation joints.

4. Base coat applied to minimum dry film thickness specified above.

5. Wearing surface, including top coats or finished coats, applied to total dry film thickness specified above, with properly graded granules evenly distributed and embedded in the wearing surface.

6. All manufacturers to provide an exterior ultraviolet (UV) stable grade topcoat throughout the entire parking structure.

D. Double Detailing (over retail)

1. After topping over retail space is cured, control joint sealant installed (and cured) provide double detailing over every joint including perimeter and double tee/double tee joints.

2. Double detailing consists of two (2) separate 6" wide strip of 25-mil base coat applied over all joints over retail space (total of 50-mils).

3. Upon completion of double detailing of joints, provide complete system as outlined in 2.1B. above.

E. Fire Hazard Rating

1. Complete liquid waterproofing system: rated Class A by Underwriters Laboratories Inc., when tested in accordance with ASTM E108. Containers shall bear the UL label.

F. Color

1. Manufacturer's standard gray, unless otherwise indicated on the Finish Schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Applicator present, for compliance with requirements and for other conditions affecting performance of traffic coatings.

1. Verify compatibility with and suitability of substrates.

2. Begin coating application only after minimum concrete curing and drying period recommended by traffic coating manufacturer has passed, after unsatisfactory conditions have been corrected, and after surfaces are dry.

3. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Clean and prepare substrates according to manufacturer's written recommendations to produce clean, dust-free, dry substrate for traffic coating application.

B. Mask adjoining surfaces not receiving traffic coatings, deck drains, and other deck substrate penetrations to prevent spillage, leaking, and migration of coatings.

C. Concrete Substrates: Mechanically abrade concrete surfaces to a uniform profile according to ASTM D 4259 and the International Concrete Repair Institute (ICRI) Surface Preparation Level 6 or 7. Do not acid etch.

1. Remove grease, oil, paints, and other penetrating contaminants from concrete.

2. Remove concrete fins, ridges, and other projections.

3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.

4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D 4258.

3.3 TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written recommendations.

B. Provide sealant cants at penetrations and at reinforced and nonreinforced deck-to-wall butt joints.

C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.

D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and traffic coating manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Comply with recommendations in ASTM C 1193 for joint-sealant installation.

3.5 CURING AND PROTECTING

A. Cure traffic coatings according to manufacturer's written recommendations. Prevent contamination and damage during application and curing stages.

B. Protect traffic coatings from damage and wear during remainder of construction period.

END OF SECTION

SECTION 07 19 00 - WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes clear water-repellent coatings for the following traffic horizontal surfaces:

1. Concrete (unpainted) including all supported area and slab on grade.

2. Areas to receive "Traffic Coatings" do not receive sealer.

B. Related Sections include the following:

1. Division 3 Sections for concrete work including floor sealers and curing agents, precast concrete, and concrete restoration and cleaning.
2. Division 7 Section "Joint Sealants" for joint sealants.
3. Division 7 Sections for "Traffic Bearing" waterproofing.
4. Division 9 Section "Painting" for paints and coatings.

1.3 PERFORMANCE REQUIREMENTS

A. Provide water repellents with the following properties based on testing manufacturer's standard products, according to test methods indicated, applied to substrates simulating Project conditions using same materials and application methods to be used for Project.

1. Absorption: Minimum 90 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens.
   a. Hardened Concrete: ASTM C 642.
2. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E 96.
3. Chloride-Ion Intrusion in Concrete: Transportation Research Board, National Research Council's NCHRP Report 244, Series II tests.
   a. Reduction of Water Absorption: 80 percent.
   b. Reduction in Chloride Content: 80 percent.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's specifications, surface preparation and application instructions, recommendations for water repellents for each surface to be treated, and protection and cleaning instructions. Include data substantiating that materials are recommended by manufacturer for applications indicated and comply with requirements.

B. Applicator Certificates: Signed by manufacturer certifying that the applicator complies with requirements.

C. Certification by water repellent manufacturer that products supplied comply with local regulations controlling use of VOCs.

D. Material Test Reports: Indicate and interpret test results for compliance of water repellents with requirements indicated.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who employs only persons trained and approved by water repellent manufacturer for application of manufacturer's products.

B. Regulatory Requirements: Comply with applicable rules of pollution-control regulatory agency having jurisdiction in Project locale regarding VOCs and use of hydrocarbon solvents.

1.6 PROJECT CONDITIONS

A. Weather and Substrate Conditions: Do not proceed with application of water repellent under any of the following conditions, except with written instruction of manufacturer:

1. Ambient temperature is less than 40 deg F
2. Concrete surfaces and mortar have cured for less than 28 days.
3. Rain or temperatures below 40 deg F are predicted within 24 hours.
4. Application is earlier than 24 hours after surfaces have been wet.
5. Substrate is frozen or surface temperature is less than 40 deg F.
6. Windy condition exists that may cause water repellent to be blown onto vegetation or surfaces not intended to be coated.

1.7 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty, executed by the applicator and water repellent manufacturer, covering materials and labor, agreeing to repair or replace materials that fail to provide water repellency within the specified warranty period. Warranty does not include deterioration or failure of coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new joints and cracks in excess of 1/16 inch wide, fire, vandalism, or abuse by maintenance equipment.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Products: Subject to compliance with requirements, provide one of the following:

1. Silane at rate of 175 s.f./gallon
   a. ISOFlex- 618 40 V.O.C. by LymTal International.
   b. Chem-Trete BSM 40 V.O.C. by Degussa Corporation.

c. Silane 40 V.O.C. by Chemrex.

d. Penetrating 40 V.O.C. by Sonneborn Building Products.

e. Pre-approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to repellent manufacturer's written instructions, to ensure surface is sufficiently dry.

1. Formed Concrete: Remove oil, curing compounds, laitance, and other substances that could prevent adhesion or penetration of water repellents.

B. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live plants and grass.

C. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

D. Test Application: Before performing water-repellent work, including bulk purchase and delivery of products, prepare a small application in an unobtrusive location and in a manner approved by Architect to demonstrate the final effect (visual, physical, and chemical) of planned application. Proceed with work only after Architect approves test application or as otherwise directed.

1. Revisions of planned application, if any, as requested by Architect, will be by Change Order if they constitute a departure from requirements of Contract Documents at the time of contracting.

3.2 APPLICATION

A. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated. Use coverage rate of 175 s.f. / gallon.

B. Do not apply product in areas to receive traffic-bearing waterproofing.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide services of a factory-authorized technical service representative to inspect and approve the substrate before application and to instruct the applicator on the product and application method to be used.

3.4 CLEANING

A. Protective Coverings: Remove protective coverings from adjacent surfaces and other protected areas.

B. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

END OF SECTION

SECTION 2x 01 00 – FIRE PROTECTION, PLUMBING & HVAC GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED CONTRACT DOCUMENTS

A. The provisions of the Instructions to Bidders, General Conditions, Supplementary Conditions, Alternates and Addenda are a part of this Specification. Contractors and Subcontractors shall examine these provisions as they may affect work under this Division.

B. Contractor shall examine Division 1 Contract Documents for general project requirements.

C. Contractor shall also examine the Contract Documents of all Divisions which may affect work under this Division. Contractor shall be responsible for Plumbing work required.

1.2 DESCRIPTION OF WORK

A. Plumbing, Architectural, Electrical, HVAC, Fire Protection, Structural, Civil, Technology and all other Drawings as well as the Specifications for all the Divisions shall be defined as the Contract Documents. Contractor shall review entire set of Contract Documents prior to bidding.

B. Drawings and Specifications are to be considered as supplementing each other. Work specified but not shown, or shown but not specified, shall be performed or furnished as though mentioned in both the Specifications and the Drawings.

C. Prior to submitting bid, Contractor shall examine all Drawings and Specifications to develop a complete understanding of the project scope. Contractor shall ask for clarifications during the pre-bid phase of the project. Failure to do so will not relieve the Contractor of their responsibility to perform all required work.

D. Bid shall include any special phasing requirements related to the construction work as described in the Contract Documents. Coordinate with Division 1.

E. Extra costs which might result from deviations from the Drawings, so as to avoid interferences, shall be considered a "Job Condition", and no additional compensation shall be considered applicable. In the event that such interferences occur in course of the work, due to an error, omission, or oversight by the Contractor, no additional compensation shall be allowed. Interferences that may occur during the course of construction shall be brought to the immediate attention of the Architect and Engineer, and the Architect and Engineer's decision, confirmed in writing, shall be final.

F. The following general terms as used within the context of the Plumbing Contract Documents shall be defined as follows:

1. "Contract Documents" – The complete set of Drawings and Specifications for all Divisions included in the project.

2. "Drawings" – Drawings furnished as part of the Contract Documents.

3. "Contractor" – Plumbing Contractor and the Plumbing Contractor's Subcontractors.

4. "Responsible" – To perform work required.

5. "Furnish" – To supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, and similar operations.

6. "Install" – Work which includes the actual unloading, unpacking, assembly, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar

operations.

7. "Provide" – To furnish and install, complete and ready for the intended use.

8. "Equal" – To meet or exceed the standards of the specified products or listed manufacturers.

9. "Mechanical" – Plumbing, HVAC and Fire Protection Divisions as applicable.

1.3 WORK INCLUDES

A. Include all labor, material, equipment, services, permits, fees, coordination, supervision and administration necessary for the proper completion of all Plumbing work shown. Items omitted, but necessary, to make the Plumbing systems complete and workable shall be understood to form part of the work.

B. Material for work required to complete installation such as earthwork, concrete, masonry, mortar, reinforcing steel, patching and painting shall be provided as specified in other applicable Divisions covering such work.

C. Provide material and labor which is neither drawn nor specified but which is obviously a component part of and necessary to complete work and which is customarily a part of work of similar character.

D. Include all testing, test reports, system programming, start-up reports and warranties for each system as outlined elsewhere in these Specifications. Refer to "Operating and Maintenance Manuals" for additional requirements.

1.4 PERMITS AND FEES

A. Secure and pay for permits and inspections required for the Plumbing work. Turn over certificates of approval to the Owner or Construction Manager promptly when received, and before payment is made for the work.

B. Give proper authorities notice as required by law relative to the work in their charge. Comply with the regulations regarding temporary enclosures, obstructions or excavations and pay all legal fees involved.

C. Make payments to all Public Utilities for work performed by them in providing service connections, including tap-in fees.

1.5 QUALITY ASSURANCE

A. Work shall be installed in accordance with provisions of all applicable codes, as interpreted by the local Authority Having Jurisdiction (AHJ), as well as any further modifications or regulations published by local or State Authorities.

B. Reference to the codes and standards listed shall constitute the minimum acceptable requirements. Nothing in the Specifications shall be construed to permit deviation from the requirements of the governing code. Where requirements of the Drawings and Specifications exceed those of the code listed, follow the Drawings and Specifications.

C. The following building codes with amendments shall be followed:

1. 2017 Ohio Building, Mechanical and Plumbing Codes

2. 2017 Ohio Fire Code

D. Lead-free Compliance

1. In compliance with "The Reduction of Lead in Drinking Water Act" signed into federal law on January 4, 2011 and in effect as of January 4, 2014, all applicable products and materials installed shall meet the standard of ANSI/NSF 372 pertaining to any wetted surfaces of pipes, pipe fittings, plumbing fittings, and plumbing fixtures having a weighted-average lead content of no more than 0.25% (0.20% for solders and flux) when used in applications intended to convey or dispense water for human consumption through drinking or cooking.

2. Model numbers specified herein may or may not reflect manufacturer's updated compliant versions; however distinguishing product identification is required of the manufacturer per the ANSI/NSF 372 standard. It is the intent of this specification to specify only compliant versions of any model or product whether a revised number is available, or not at the time of this printing.

3. It is the responsibility of the installing contractor to secure only compliant materials, equipment, components, etc. for installation. Formerly made versions or models of equipment containing non-compliant components are not acceptable.

E. Applicable portions of the following codes, standards, societies and agencies shall be followed. Where a specific edition is listed, it shall be used. Where not listed, the edition recognized by the Authority Having Jurisdiction shall be used. Listing of a specific portion of a code, standard, society or agency does not preclude the Contractor from following all other applicable portions of the code, standard, society or agency.

1. American National Standards Institute (ANSI)

2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

3. ASHRAE 90.1-2010: Energy Standard for Buildings

4. American Society of Mechanical Engineers (ASME)

5. American Society of Sanitary Engineers (ASSE)

6. American Society of Testing and Material (ASTM)

7. American Water Works Association (AWWA)

8. American Welding Society (AWS)

9. Americans with Disabilities Act (ADA) - Americans with Disabilities Act Accessibility Guidelines (ADAAG)

10. Cast Iron Soil Pipe Institute (CISPI)

11. Federal Occupational Safety and Health Act (OSHA)

12. National Electric Code (NEC)

13. National Fire Protection Association (NFPA)

14. Underwriters Laboratories, Inc., Standards for Safety (UL)

1.6 ELECTRONIC MEDIA

A. Electronic drawing files are available to the Contractor, from the Engineer for coordination purposes as defined in Division 0 and Division 1.

B. Contractor shall deliver closeout documents on a portable memory device. Portable memory

device shall refer to CD, DVD, Flash Drive, external hard drive or any other portable media used for storing electronic files.

1.7 SUBMITTALS

A. Prior to commencing work, submit product data and/or shop drawings for Plumbing equipment, materials and systems as described herein and as required in each individual Division 22 Specification section. Provide all Submittals far enough in advance of scheduled dates for installation to provide sufficient time for reviews, for securing necessary approvals, for possible revisions and re-submittals, and for placing orders and securing delivery.

B. Conform to submittal requirements outlined in Division 1 Specifications. Provide Submittals in an electronic format. The file format shall be portable data file (.pdf).

C. Prepare Submittals with adequate details and dimensions as necessary to clearly show construction. Clearly identify each item on the submittal with designation as indicated on Drawings including location and use. Include with Submittals Manufacturers published descriptive literature, specifications, performance data (normal operating characteristics, curves, ratings, etc.), wiring diagrams and installation instructions. Indicate for each item the operating characteristics, design conditions, features, and optional items that are intended for application on this project. Where contents of Submittal literature includes data not pertinent to the Submittal, clearly indicate (highlight) which portion of content is being submitted for review.

D. If for any reason, the Submittal shows variations from the requirements of the Contract Documents, the Contractor shall make mention of such variation in the letter of transmittal. The Contractor shall note in red on the Submittal any change in design or dimension on the items submitted including changes made by the Manufacturer which may differ from catalog information.

E. Where additional installation drawings, wiring diagrams or other drawings are specified elsewhere as part of the project requirements, they shall be submitted at the same time as the Submittals. Partial Submittals are not acceptable.

F. Contractor shall review each Submittal prior to submission, and check for compliance with the Contract Documents. Corrections shall be noted. Mark with approval stamp prior to submission. Submittals that do not bear the Contractor's approval stamp will be returned without action.

G. The Submittals will be reviewed only for General compliance and not for dimensions, quantities, etc. The Submittals that are returned shall be used for procurement. The responsibility of correct procurement remains solely with the Contractor. The Submittal review shall not relieve the Contractor of responsibility for errors or omissions and deviations from the Contract Document requirements. Submittals which are not required under this Division shall be returned to the Contractor.

H. After review of submittals by the Engineer, the Contractor shall revise and resubmit if required to establish compliance with the Contract Document requirements. Resubmittal shall include a document with a written response to each of the Engineer's previous comments.

I. The Contractor shall notify the Engineer when all product data and/or shop drawings for Plumbing equipment, materials and systems have been submitted for review.

J. The Contractor agrees that Submittals, processed by the Engineer, are not change orders; that the purpose of submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design intent of the project. This understanding is demonstrated by indicating which equipment and material is required, and by what methods of fabrication and installation will be utilized.

K. The Contractor further agrees that if deviations, discrepancies or conflicts between the Submittals

and the Contract Documents are discovered, either prior to or after Submittals are processed by the Engineer, the Drawings and Specifications shall control and shall be followed.

L. Final reviewed submittals shall be included in the Operating and Maintenance Manuals. Where Submittals are returned "REVIEWED, EXCEPTIONS AS NOTED", the final Submittals shall be updated to include the exceptions. Upon ordering equipment, order sufficient number of sets of product data literature for the Operating and Maintenance Manuals.

M. Submit product data for the following. Refer to specific Specification sections for additional requirements.

1. Basic Materials and Methods

2. Insulation

3. Equipment

4. Any other specified system or equipment not listed

1.8 CONSTRUCTION DOCUMENTATION

A. Coordination Drawings

1. Refer to Division 1 for additional requirements.

2. Preparation of the Coordination Drawings shall be the responsibility of the HVAC Contractor.

3. Coordination Drawings shall include but not be limited to: locations of equipment and devices, ductwork, piping, and conduit routing and required service clearances for all trades. Show the relationship of all components as related to installation and future access for maintenance and removal. Where access doors are required, indicate locations and type. Show locations of all ductwork, piping and conduit penetrations through wall and floors.

4. Supply HVAC Contractor information necessary for the development of Coordination Drawings. Information shall include but not be limited to: locations and sizes of Plumbing equipment and devices; piping routing and sizes; and required service clearances affecting the work of other trades. How this information is supplied shall be discussed and decided between all trades. Coordination meetings between all trades are required.

5. Before supplying information to the HVAC Contractor, coordinate locations of all floor, wall, and roof penetrations including sleeve requirements with General Trades. Coordinate locations and types of all access doors with the Architect and General Trades.

6. Contractor shall approve Coordination Drawings prior to submittal to Architect for review and must indicate acceptance of illustrated conditions by attaching their endorsement to each Drawing.

7. Proceed with installation only after review of Coordination Drawings by Architect and approval from other trades affected. Architect does not approve Coordination Drawings.

8. The Coordination Drawings shall be updated to include any deviations made during construction as required to create Record Drawings.

B. Pressure Tests and Disinfection

1. Submit pipe system pressure testing and disinfection documentation to Engineer upon completion.

2. Refer to Section 22 03 00 for additional information.

3. Final copies shall be included in the Operating and Maintenance Manuals.

1.9 GUARANTEE AND WARRANTIES

A. Warrant that equipment and all work is installed in accordance with good workmanship practice. All equipment shall be installed in accordance with the Manufacturer's recommendations and shall meet the requirements specified. Any equipment failing to perform or function as specified shall be replaced with complying equipment without cost to the Owner. Warranty shall commence upon acceptance of substantial completion of construction by the Owner. Sign-off of individual equipment start-up procedures shall not activate the warranty commencement.

B. Guarantee against defects in workmanship and materials; repair or replace any defective work, material or equipment within one year from date of formal written warranty commencement. Longer product warranties provided by individual equipment manufacturers shall supersede this one year guarantee; however, the Contractor shall maintain the one year workmanship and materials guarantee for installation of such equipment. Coordinate guarantee and warranty requirements with Division 1 Specifications.

1.10 CLOSEOUT DOCUMENTS

A. Record Drawings:

1. Record Drawings shall consist of updated Coordination Drawings as defined elsewhere in the Specifications. Refer to Division 1 for quantities, special formatting, and additional requirements.

2. The Contactor shall maintain updated Coordination Drawings, reproduced electronically from the original Coordination Drawings in an approved format. Drawings shall include any deviations or changes made during construction. Drawings shall only include Division 22 work. Work of other divisions shall be removed. At the end of the project, the Contractor shall transfer the electronic drawing files onto a portable memory device. Both hard copy drawings and the portable memory device shall be provided as Record Drawings.

3. Record Drawings shall reflect as-built conditions and show changes in:

   a. Size, type, capacity, etc. of any material, device or piece of equipment

   b. Location of any device or piece of equipment

   c. Location of any outlet or source in building service system.

   d. Routing of any piping, conduit, sewers or other building services.

4. Record Drawings shall indicate the location of all underground, under floor and concealed piping including the location of all utility service entries.

5. Record Drawings shall indicate rated walls where firestop materials have been applied.

6. Record Drawings shall indicate the location of all tagged valves including the tag designations.

7. After the project is completed, the Record Drawings shall be delivered to the Architect for inclusion into the Operating and Maintenance Manuals, as a permanent record of the installation as constructed.

B. Operating and Maintenance Manual (OMM)

1. Furnish complete bound sets of Operating and Maintenance Manuals. Refer to Division 1 Specifications for quantities and for additional requirements.

2. Bind the required material into a hard-backed binder(s) where they can be accommodated into 8-1/2" x 11" size.

3. OMM shall be assembled as follows, unless otherwise directed in Division 1 Specifications. Include a title tab for each section and an index at the beginning of each individual section.

    a. First Page --- Title of Project, Owner, Address, Date of Submittal, Name of Contractor and Name of Engineer, including contact information, phone numbers and email addresses.

    b. Second Page --- Index

    c. First Section --- Written description of system contents including where actually located in building, how each part functions individually, and how system works as a whole. Included step by step procedures for startup and shut down for each system and piece of equipment. Conclude with a list of items requiring service and either state the service needed or refer to the Manufacturer's data in the binder that describes the proper service.

    d. Second Section --- A copy of each approved Submittal.

    e. Third Section --- A copy of each equipment Manufacturer's operating and maintenance instructions and where applicable, a copy of the equipment startup report. Maintenance instructions shall include name of service agency, spare and replacements parts lists, lubrication instructions, and replacement belt information (size, type and length). For packaged equipment with manufacturer supplied controls, provide information listing any programming that is not a factory default.

    f. Fourth Section --- A copy of all test results performed by the Contractor. Test results shall include pipe pressure tests and disinfection. Wall hung fixture carrier sign-off approvals

    g. Fifth Section --- A copy of all valve directories.

    h. Sixth Section --- A copy of all guarantees and warranties.

    i. Seventh Section --- Owner training sign-in sheets.

    j. Eighth Section --- Record Drawings.

    k. Ninth Section --- A list of attic stock furnished for the project.

    l. Tenth Section --- Final Punch List with Contractor's responses.

4. Once submittals are completed, provide an OMM index to the Engineer for review. Once index is approved, submit an electronic copy of the OMM to the Engineer for acceptance. If any sections are incomplete, include section title tab and a page describing what is missing. After acceptance, submit the required quantity of final hard copies to the Architect for delivery to the Owner. If data is missing from final copies, a page shall be inserted into the front of the OMM listing what is missing and a date when the data will be available for insertion into the OMM.

5. After acceptance, information contained within the OMM shall be transferred onto a portable memory device and delivered with the OMM. Data shall be in .pdf format and submitted as a bookmarked electronic document utilizing interactive index tabs. In addition, a portable

memory device shall be delivered to the Engineer.

a. OMM index page shall have cross-reference links to each section.

b. Sections containing more than 30 pages shall have a section index with cross-reference links.

1.11 OWNER TRAINING

A. Before final payment, demonstrate to the Owner's satisfaction the proper operation of each of the systems provided as part of the Contract Documents.

B. Provide to Owner after all equipment, systems and controls are in operation and at an agreeable time, instructions for the purpose of training Owner's maintenance personnel in the operation and maintenance of all Plumbing equipment, systems and controls.

C. Provide a "sign-in" sheet at each training session. A copy of each "sign-in" sheet shall be included in the Operating and Maintenance Manual.

D. Refer to individual Division 22 sections for minimum time periods for training.

E. Deliver to the Owner all special tools and appurtenances for proper operation and maintenance of the equipment provided and request receipt for same. Attach to the Contractor's request for final payment.

1.12 SITE REPORTS AND PUNCHLISTS

A. The Engineer may visit the site periodically during construction and provide written Construction Observation Reports to the Contractor identifying areas where installation does not meet the intent of the Contract Documents. The Contractor shall provide a written response to these reports within 5 business days, indicating the reason the installation is out of compliance with the Contract Documents. After review, the Engineer may or may not require the Contractor to correct the installation.

B. Final Punch List

1. The Engineer will visit the site to perform a scheduled Final Punch List to identify areas where the installation is incomplete or does not meet the intent of the Contract Documents.

2. If the Engineer is requested to perform the Final Punch List prior to the Contractor being 100% complete with their scope of work, the Contractor shall furnish a Contractor's Completion List, indicating all incomplete work. This list shall be furnished to the Engineer a minimum of 24 hours prior to the scheduled Final Punch List.

3. The Contractor shall respond to each punch list item along with a date, indicating that the item has been completed or corrected.

4. A copy of the Final Punch List with the Contractor's responses shall be included on the Operating and Maintenance Manual.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. All equipment and materials used on this project shall be new and UL Listed for the intended application. Where possible, the same brand or manufacturer shall be used for each type of material or equipment.

B. Equipment and materials for the construction shall be the responsibility of the Contractor and shall be protected by the Contractor until formally accepted by the Owner.

C. All Manufacturers of Plumbing equipment shall verify to the satisfaction of the Contractor and Engineer that their equipment will function properly under the conditions of use, as shown on the Drawings and as specified herein. Dimensions, weights, operating characteristics and all other related appurtenances shall be verified before submittal of shop drawings.

D. Steel products used for load-bearing structural purposes shall be made in the United States as required by the Ohio Revised Code, Chapter 153.

2.2 MATERIAL SUBSTITUTIONS

A. Bids shall be based upon the specified products, suppliers or listed alternatives. The Drawings and Specifications are based on the products specified by type, model, size and suppliers if indicated and thus establish minimum qualities which substitutes must meet to qualify for review.

B. Should the Contractor propose to furnish materials, equipment and/or suppliers other than those specified, submit a written request for substitutions to the Architect or Engineer in accordance with Division 1 requirements. The request shall be an alternate to the original Bid and shall be accompanied with complete descriptive (manufacturer, brand name, catalog number, supplier name and references, etc.) and technical data for all items. Indicate any additions or deductions to the base Bid price.

C. Where listed alternatives, substitutions or equipment manufacturers (other than the basis of design) alter the design or space requirements indicated on the Drawings, the Contractor shall be responsible for the revised design and construction including cost of all associated trades involved.

D. Acceptance or rejection of the proposed substitutions shall be subject to approval of the Architect or Engineer. If requested, the Contractor shall submit inspection samples of both the specified and the proposed substitute items for review.

E. In all cases where substitutions are permitted, the Contractor shall bear any and all extra cost of evaluating the equality of the material and equipment to be installed.

F. Where only one Manufacturer or supplier is named in the Contract Documents, the system or equipment shall be provided as specified.

G. Verbal requests or approvals of substitutions shall not be binding on the Architect, Engineer or Owner.

PART 3 - EXECUTION

3.1 SAFETY

A. The Contractor shall follow all safety requirements as defined herein, as described in Division 1 and as defined by Owner safety protocols.

B. Work shall be performed on de-energized equipment in accordance with NFPA 70E.

3.2 COORDINATION

A. Consult the Contract Documents and Submittals pertaining to the work for other trades. Review the field layouts for all trades and make adjustments accordingly in laying out the Plumbing work.

B. Examine the work of all other trades when it comes in contact with, or is covered by, work in this Division. Do not attach to, cover up, or finish against any defective work, or install work in a

manner which will prevent proper installation of the work of other trades. Plumbing Contractor shall be responsible for the costs of adjustments required.

C. Take all field measurements necessary and assume responsibility for the accuracy.

D. Install work that is to be concealed within the building construction in sufficient time to secure proper location without delay to the work of other trades.

E. Assume responsibility for location of chases, other openings through masonry and concrete construction. When work cannot be installed concurrent with building construction, arrange for rough-in boxes, sleeves, inserts and other items, as necessary for installation thereof at a later date.

F. If any work is installed so that the architectural design cannot be adhered to, Contractor is responsible for making such changes as Architect may require. Before installing work, report any interferences between work of this Division and work of other Divisions to Architect as soon as discovered. Architect will determine which work must be relocated, or make adjustments to maintain clearances, maximum headroom and to avoid conflict with other work.

G. Become familiar with the construction where work attaches. Review Structural Drawings for coordination of openings. Cut no structural members or slabs without Architect's written approval.

H. Exercise caution when working in areas where concealed systems or materials may exist. Any costs for repair of damage incurred shall be the responsibility of Contractor causing the damage.

3.3 PROTECTION

A. All finished surfaces shall be protected from damage and spills during construction.

1. Protect finished floors with a heavy duty flexible fiber reinforced floor protection board – Ram Board or equal.

2. When setting up pipe cutting and threading machines, protect area against staining and abrasion.

3. Protect finished surfaces from chips and cutting oil by use of a chip receiving pan and oil proof cover.

4. Protect equipment and finished surfaces from welding and cutting spatters with baffles and spatter blankets.

5. Protect finished surfaces from paint droppings, insulation adhesive, etc. by use of drop cloths.

B. Cost of correcting any such condition will be charged against the respective Contractor.

3.4 PRODUCT HANDLING

A. Pay all costs for transportation of materials, equipment to job site.

B. Provide all scaffolding, tackle, hoists, rigging necessary for placing Plumbing materials and equipment in their proper place. Scaffolding, hoisting equipment: comply with applicable Federal, State, and Local regulations. Remove temporary work when no longer required.

C. Arrange for packaging of equipment, which must be hoisted, so that there will be no damage or distortion caused by hoisting operation. Protect all piping, ductwork, and equipment from any damage during hoisting operation.

D. Store equipment, fixtures, controllers, insulation, etc., in dry location and protect from dirt and moisture until building is ready to receive them.

E. Coordinate location of stored items with other trades. Where necessary, store materials and equipment on movable carts so they may be moved when interfering with the work of other trades.

3.5 CUTTING AND PATCHING

A. All cutting and patching in construction as necessary for installation of this work shall be the responsibility of this Division and performed by the Tradesmen related to that specific Division of work. Subcontract this work to the appropriate Trade Division.

B. Where locations of penetrations are inaccurate or where building components are improperly cut by inadequate methods, the Contractor in error shall be responsible for complete repair.

3.6 DAMAGE AND EMERGENCY REPAIRS

A. Assume responsibility for any damage to new or existing building components caused by work provide as part of the Contract Documents, including leaks in piping systems being installed or reworked. Repair all damage without extra cost to Owner.

B. Owner reserves the right to make emergency repairs as required to keep equipment in operation, without voiding Contractor's guarantee or relieving him of responsibility during warranty period.

3.7 CLEANING

A. At all times keep premises and building in neat and orderly condition, follow explicitly any instructions in regard to storing of materials, protective measures and disposing of debris.

B. After all tests and adjustments have been completed, clean all equipment leaving everything in working order at the completion of this work. Thoroughly clean all piping, fixtures and equipment of dirt, dust, grease, oil, debris and paint, after all other trades have completed their work.

C. All debris created by the execution of this work shall be removed as directed by the Architect or Owner.

D. Upon completion of work remove all tools, equipment and surplus materials.

3.8 PAINTING

A. Finish painting is included under Division 9 - Finishes.

B. Materials and equipment installed under this Division shall be left free from dirt, grease and foreign matter, ready for painting.

C. No equipment or piping shall be painted before being tested.

D. Damaged surfaces of prefinished materials and equipment shall be touch-up painted to match existing finish.

END OF SECTION

SECTION 21 03 00 – FIRE PROTECTION BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDES

Pipe and Fittings
Valves
Sleeves
Inserts, Hangers and Supports
General Installation Requirements
General Piping
Welding
Flushing
Startups
Tests and Adjustments

1.2 SUBMITTALS

A. Refer to Sections 21 01 00 and 21 01 01 for submittal requirements and to individual sections for detailed requirements.

1.3 CONSTRUCTION DOCUMENTATION

A. Refer to Section 21 01 00.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Above Ground

1. Pipe and tube for and dry standpipe systems shall be galvanized, welded or seamless steel as scheduled in NFPA 13. Piping joined with threaded fittings shall have a minimum of schedule 40 wall thickness. Roll grooved piping or welded piping shall have a minimum of schedule 10 wall thickness. Cut grooves shall not be permitted. All pipe shall be provided with a factory antimicrobial coating to assist in limiting corrosion from MIC or other microbes.

    a. Threaded Fittings shall be cast or malleable iron type in accordance with NFPA 13.
    b. Utilize galvanized fittings on galvanized pipe.

2. Groove joining shall be done by an approved combination of domestically produced fittings, couplings, pre-lubricated gaskets and grooves. Grooves on pipe shall be dimensionally compatible with fittings. Acceptable suppliers are Victaulic Company of America, or approved equivalent by Grinnell Mechanical Products, or Anvil International-Gruvlok.

    a. The grooved coupling Manufacturer's Representative shall provide an on-site training session with the Contractor's sprinkler fitters to ensure that the products are being properly installed and utilized. The Contractor shall provide documentation of such training to the Professional.
    b. Couplings shall consist of two ductile iron housing segments to ASTM A536, pressure responsive elastomer gasket to ASTM D2000, and zinc-electroplated steel bolts and nuts to ASTM A449 or ASTM A-183.
    c. Grooved fittings. All mechanical fittings and couplings shall be manufactured by the same company and be suitable for use on fire system.
    d. Flange Adapter: Flanged connection transitions shall be made via approved adapters.

e. Gaskets shall be compatible with the manufacturers coupling and be approved for fire protection service for the application.

3. Other galvanized pipe applications include:

a. All miscellaneous drain and test piping and fittings shall be Schedule 40 internally and externally galvanized.

2.2 VALVES

A. Valves for Fire Protection systems shall be UL Listed and FM Approved for Fire Protection Service.

B. Typical Manufacturers include but not limited to: Kennedy, Mueller, Nibco, and Victaulic.

C. All valves in each system, except for special types, shall be the product of a single manufacturer.

D. Valves shall have the name or trademark of the manufacturer and the working pressure stamped or cast on the valve body. Valves shall have listing or approval agency identification mark stamped or cast on valve body.

E. Valves shall have a working pressure rating consistent with the maximum operating pressure of the system (nominally rated at 175 or 250 psi).

F. Auxiliary valves (e.g. drain valves) need not be listed for Fire Protection Service.

2.3 SLEEVES

A. Where pipes pass through masonry or concrete walls, set machine cut steel pipe sleeves 1 inch larger than outside diameter of pipe, with ends of sleeves flush with wall faces. Sleeves in partitions other than masonry or concrete where firestopping is required: 28 gauge galvanized steel sheet or as specified by the firestopping manufacturer's literature.

B. Where pipes pass through floors, set Schedule 40 galvanized steel pipe sleeves 1 inch larger than the outside diameter of the pipe. Top of sleeve to be 4 inches above finished floor in machine rooms and wet floor locations. Seal along the outer edge of the sleeve.

C. Set sleeves true to line, grade; position and plumb or level and so maintain throughout construction period.

D. Where concrete or masonry walls are core drilled for pipe passage steel sleeves are not required.

2.4 INSERTS, HANGERS, AND SUPPORTS

A. All piping shall be supported per NFPA 13 requirements. The portion of the hanger that directly attaches to the piping or the building structure shall be listed for that purpose.

B. Hanger spacing, support of vertical pipes/risers, and trapeze hangers shall be as required by NFPA. There shall not be less than one hanger for each section of pipe.

C. Provide all inserts, hangers, anchors, guides and supports to properly support and retain piping, conduits and equipment; to control expansion, contraction, anchorage, drainage and prevent sway and vibration.

D. Provide supplementary angles, channels, and plates where supports are required between building structural members, span the space and attach to building structural members by welding, bolting or anchors.

E. Provide hangers, threaded rods, turnbuckles, anchors, and all other miscellaneous specialties for the attachment of hangers and supports to structure.

F. Provide rods, angles, rails, struts, brace plates, and platforms required for suspension or support of piping, conduit and equipment.

G. Support individual piping from hangers as manufactured by Anvil, Erico or Caddy.

H. Provide additional lock nut on each threaded support rod.

I. Provide additional hanger support within two feet of each elbow and at valves, and other equipment in pipe lines.

J. Do not suspend a pipe from another pipe or ductwork. Fire Protection System piping shall not be supported from the bottom chord of bar joists.

K. Do not bend or angle threaded rod. Hangers used on sloped or angled structures shall be of the articulating beam clamp style or follow the NFPA 13 allowance for reducing lateral loads.

L. The use of powder driven anchors for hanging of fire protection equipment is generally prohibited. The use of powder driven anchors may be permitted for certain applications where no other reasonable alternative exists. Specific approval by the Professional or CM is required prior to use.

M. Methods of hanging fire protection piping shall include the requirements of seismic restraints of piping indicated in NFPA 13, in accordance with the International Building Code, for Architectural, mechanical and electrical components and systems.

2.5 SYSTEM AND EQUIPMENT IDENTIFICATION

A. Equipment Nameplates

1. Equipment nameplates shall be laminated phenolic with a black surface and white core. Use 1/16 inch thick material for plates up to 2 inch by 4 inch. For larger sizes use 1/8 inch thick material.

2. Lettering shall be condensed Gothic. The space between lines shall be equal to the width of the letters. Use ¼ inch minimum height letters which occupy four to the inch.

3. Nameplates shall be attached to equipment with brass screws or rivets; no adhesive attachments will be permitted.

4. Acceptable Manufacturers: Seton Nameplate Company, Marking Services Inc.

B. Valve Tags

1. Tags shall be 2" diameter, 1/16" thick, multilayered acrylic with engraved letters.

2. Lettering shall be ¾" high for type service and ½" for number. Tag shall indicate service and valve number. Letter and number designations shall be coordinated with the Owner.

3. Each service shall be a different color in conformance with the "Scheme for the Identifications of Piping Systems" (ANSI A13.1).

4. Tag shall be attached with chain similar to Seton No. 16 stainless steel jack chain. Use of beaded chain or wire is not acceptable.

5. Acceptable Manufacturers: Seton Nameplate Company, Marking Services Inc.

C. Pipe Markers

1. Each marker background shall be appropriately color coded with a clearly printed legend to identify the contents of the pipe in conformance with the "Scheme for the Identifications of Piping Systems" (ANSI A13.1).

2. Flow direction arrows shall be included on each marker.

3. Snap-around markers shall be used for overall diameters up to 6" and strap-around markers shall be used above 6" overall diameters.

4. Acceptable Manufacturers: Seton Nameplate Company, Marking Services Inc.

D. Utility Entrance Designations

1. Brass wall plaque, minimum 0.020" thick with wording describing the utility.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Location of piping, equipment, and any sprinkler heads on the drawings are diagrammatic; indicated positions shall be followed as closely as possible, exact locations shall be subject to building construction and interferences with other work. In general, conceal piping located outside of equipment rooms and where ceilings exist. Difficulties preventing the installation of any part of work as indicated, shall be called to the attention of the Architect. Architect will determine locations and changes. Contractor shall install the work accordingly. Architect reserves right to make minor changes in location of any part of the work up to the time of roughing-in without additional cost.

B. Install all materials and equipment in a neat and workmanlike manner by competent specialist for each subtrade. The installation of any materials and equipment not meeting these standards may require removal and reinstallation at no additional cost to the Owner.

C. Locate piping and other services to ensure maximum accessibility.

D. Install, connect equipment, services, and materials according to best engineering practice and in conformity with manufacturer's printed instructions. Provide complete auxiliary piping, water seals, valves, electric connections, controls, etc., as recommended by respective equipment manufacturer or required for proper operation.

E. Take all measurements and determine all elevations at the building.

3.2 ACCESS TO EQUIPMENT AND DEVICES

A. All valves, equipment, and other devices requiring examination, adjustment, service, and maintenance shall be accessible.

B. To ensure accessibility during and after construction, when a device is installed, its location shall be marked with securely attached temporary signage. Signage shall indicate the amount of clearance required for the specific device. Signage shall remain in place until the ceiling or access door is installed or until substantial completion.

C. Clearance shall include not only code required clearance but also clearance for Owner's staff to access the device. This access shall be from the floor or from the floor level using normal maintenance ladders and apparatus to meet all OSHA requirements. Consideration shall be given to accessing a device through an access door.

D. Where a device is installed above finished ceilings, signage shall be hung below the device at

the finished ceiling level. Where a device is exposed, in open ceiling areas, signage shall be hung at approximately 8' above the floor level.

E. Fire Protection Contractor shall monitor these access locations until substantial completion and notify Architect, Owner and Engineer when the access area is encroached upon so that corrective action may be taken immediately.

3.3 GENERAL PIPING

A. Drawings (floor plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. So far as practical, install piping as indicated.

B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

C. Plug open ends of pipe or equipment at all times during installation to keep dirt and foreign material out of system.

D. Arrange and install all pipes, valves, access openings and equipment so as to be accessible for service. Locate equipment to maintain clearances for periodic servicing.

E. Unless otherwise specified, make branch connections in welded steel piping less than 2/3 of main size with weldolets, butt, or threaded type. Make branch connections 2/3 of main size and larger with weld tees, laterals, or crosses. Shaped nipples are not acceptable.

F. Make reductions in piping lines with reducing coupling or weld fitting reducer.

G. Support piping so as not to place a strain on valves or equipment.

3.4 WELDING

A. Install all pressure piping systems to conform to requirements of State Piping and Welding Codes where applicable. Perform any pipe welding not covered by code by certified welders according to code procedures.

B. All welding shall be performed in the shop as per NFPA 13.

3.5 FLUSHING AND PIPE CLEANING

A. Flush piping systems with an approved bio-degradable detergent to remove pipe dope, slushing compounds, oils, welding slag, loose mill scale and other extraneous materials per NFPA requirements. Include copy of flushing report in Operating and Maintenance Manual. Flushing shall be scheduled and documented.

B. After initial period of operation clean all strainers, traps and dirt legs.

3.6 TESTS AND ADJUSTMENTS

A. The contractor shall notify the Professional and the AHJ 3 weeks or more in advance of all tests to be conducted.

B. Report test results promptly and in writing to the Professional and AHJ.

C. Obtain all inspections required by law, ordinances, rules, regulations of authorities having jurisdiction, furnish certificates of such inspections. Pay all fees, and provide all equipment, power and labor necessary for inspections and tests.

D. During testing period maintain on the project an engineer or approved manufacturer representative thoroughly familiar with all phases for as long a period as required to thoroughly

adjust all systems and demonstrate that they are functioning properly.

E. Perform all tests, including but not limited to those specified, make necessary adjustments to obtain specified equipment and system characteristics.

F. Do not consider work under this Specification complete until required inspections have been obtained, tests performed, necessary adjustments made and satisfactory evidence of compliance has been submitted. Architect reserves right to make spot checks to determine accuracy and completeness of final adjustments.

G. Piping Pressure Tests:

1. All piping shall be given a pressure test as required by Specification Section 21 10 00. Equipment which would be damaged by the required test pressure shall be isolated from the system during test.

2. Correct minor leaks in welded joints by chipping out weld and rewelding. Correct leaks in screwed joints by replacing thread or fitting or both. Caulking of threaded joints is not permitted.

3. Perform all tests before piping is concealed or covered.

4. Be responsible for completely draining the systems after hydrostatic tests are performed. Any damage from freezing prior to acceptance of the completed installation shall be repaired at no additional cost to the Owner.

5. All tests shall be scheduled and documented. Include copy of the piping system pressure test reports in the Operating and Maintenance Manual.

H. The entire system shall be tested in accordance with the requirements of NFPA 13 and all local requirements. Contractor's Material and Test Certificates shall be completed, signed, and dated and included in the Operations and Maintenance Manuals

I. Any retesting that is required due to failure of any test for any reason shall be conducted at no additional cost to the owner. Any corrections or repairs to the system or building necessary due to such a failure, and retesting of the system shall be performed at no cost to the owner.

3.7 SYSTEM AND EQUIPMENT IDENTIFICATION

A. Identify each piece of equipment as to nature of service and system number corresponding to designation in Contract Documents, by stenciling with 1 inch high letters or attaching two color engraved nameplates. Equipment designations shall conform to the Owner's Standard.

Item	Type Identification
Standpipe Risers	Refer to Section 21 10 00

B. Valve Identification

1. Identify all system and drain valves with tags attached with chain. All valves shall be designated by distinguishing numbers and letters carefully coordinated with a valve directory. All letter and number designations shall be coordinated with the Owner.

2. Designations and locations shall be accurately recorded on the Record Drawings.

3. At completion of project, provide a framed valve schedule or directory, under Plexiglass, giving number of valve, service, building location by column coordinates, floor location, manufacturer's figure number, size, and equipment controlled. For service, use designation shown in legend on drawings. Mount where directed by Owner.

C. Valve Schedule.

1. Provide a valve schedule for all valves as indicated above.

2. Every valve shall include.

   a. Tag Number
   b. Service (Sprinkler, etc.)
   c. Size
   d. Operation
   e. Location
   f. Manufacturer
   g. Model Number
   h. Submittal Reference

D. Pipe Markers

1. Identify pipe throughout facility, including in equipment rooms.

2. Markers shall be located:

   a. Adjacent to each valve.
   b. At each branch.
   c. At each cap for future.
   d. At each riser takeoff.
   e. At each pipe passage through wall (each side).
   f. At each pipe passage 20' – 0" intervals maximum.
   g. At each piece of equipment.
   h. At all access doors.
   i. A minimum of one (1) marker shall be provided at each room.

END OF SECTION 21 03 00

SECTION 21 10 00 - WATER BASED FIRE PROTECTION SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDES

Valves
Standpipe components
Fire hose valves
Accessories

1.2 SUBMITTALS

A. Refer to Section 21 01 00 and 21 01 01.

1.3 DESIGN REQUIREMENTS

A. Design system and prepare the fire protection drawings and hydraulic calculations under direct supervision of a state certified sprinkler designer.

B. The Drawings indicate the general routing of fire mains.

C. Attention is called to the limited space available for the installation of fire protection services, it is essential for the coordination of all trades that this Contractor be responsible for confirming the location and elevations of piping and equipment at the job site to avoid encroaching upon the space needed and allocated for another trade.

D. Drawings are not intended to be scaled for rough – in measurement or to serve as shop drawings, installation drawings, or sleeve drawings. "Working Plans" for these purposes shall be prepared by the Contractor.

E. Where piping cannot be run concealed (e.g., areas without ceilings), the exposed piping shall be routed as inconspicuously as possible in a neat and orderly fashion.

F. The Contractor is responsible for the routing of sprinkler piping such that only piping serving the Electrical Rooms, Wiring Closets, and Telecommunication or data rooms shall be permitted to enter these rooms. Route piping so that it enters the room over the door. Routing of any piping above electrical equipment or panels shall be avoided throughout the building.

G. All drains and inspectors test connections shall be piped to the exterior or suitably sized drain risers as indicated on the drawings. All piping and fittings on the discharge side of all drain valves shall be internally and externally galvanized.

H. Auxiliary and low-point drains shall be kept to a minimum. Auxiliary drains shall be provided in accordance with NFPA 13 except that all trapped sections shall be provided with an auxiliary drain consisting of a valve 3/4" or larger and a plug or nipple and cap. Auxiliary and low-point drains that are required to be piped to an accessible location are permitted to discharge to the building exterior.

1.4 TESTS

A. The appropriate tests and flushing procedures shall be conducted as the installation progresses, as stipulated by the applicable regulations. Provide all necessary labor and equipment for such tests.

B. All tests shall be witnessed by all interested agencies unless specifically waived by the agency in writing. Adequate advance notification shall be given in writing to all such parties.

C. All pressure testing and flushing shall be in accordance with NFPA 13 requirements.

D. Perform hydrostatic test on standpipe system, to 50 PSI over maximum pressure but at least 200 PSI for 2 hours.

E. All defects made evident by the tests shall be properly repaired. Leaks shall be repaired only by means of tightening or replacing the fitting and not by any caulking method.

F. Upon completion of the entire fire protection system installation, an operating test shall be made in the presence of the purchaser, local fire officials, and representative of the authority having jurisdiction.

G. After the completion of testing and adjustments furnish three (3) copies each of signed certificates of approval or acceptance of all parts of the systems, from all authorities having jurisdiction.

H. Provide a copy of the test certificate in the OMM.

PART 2 - PRODUCTS

2.1 FIRE DEPARTMENT HOSE VALVES

A. Fire Department Valves (Standpipe Systems)

1. The standpipe system with all accessories shall be furnished and installed by this Contractor to comply with NFPA 14, UL, FM, local fire department regulations, and state and local fire protection codes.

2. Angle type valve: 2-1/2 inch size, cast brass polished brass rough chrome polished chrome UL listed with Local Fire Department threads. Verify with local authority.

3. Provide 2-1/2 inch by 1-1/2 inch reducer. Provide with cap and chain.

2.2 FIRE DEPARTMENT CONNECTIONS

A. Wall Storz: Aluminum adapter with 4x4 4x6 6x4 6x6 Storz inlet, female NPT outlet. Cast brass escutcheon plate. Hard coated aluminum Storz cap with attachment cable. Provide with 30 degree turndown body. Standard finish – Aluminum with brass plate. Provide with optional chrome plated finish. Branding shall read "Auto Spkr" "Standpipe" "Auto Spkr/Standpipe" Croker No. 6350 series, Elkhart or Potter-Roemer.

B. Where applicable, install a sillcock or 90-degree elbow with drain connection at the Fire Department Siamese connection. Elbow shall be Victaulic #10-DR.

C. Where required by Local Fire Department, provide Knox Locking caps.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Install fire protection risers at location indicated.

B. Furnish all labor, necessary construction equipment, materials necessary for the complete installation of the fire protection system as indicated. All work shall be in strict compliance with all governing state and local code requirements, in full conformity with the best current trade practices and subject to approval of the Architect or his Representative.

C. All work details not covered in these Specifications shall be governed by the requirements of the latest edition of NFPA 13.

D. Piping shall be screwed, welded, flanged or joined with mechanical fittings. All welding shall be performed in conformance with NFPA 13.

E. Insulate connections between pipe fittings, hangers of dissimilar metal against direct contact. Use di-electric insulating flanges and unions.

F. Support all standpipe risers, as specified in NFPA 13 and 14.

G. Reducers shall be eccentric and installed in piping so that piping can be drained.

H. All drain lines shall terminate with turned down ells and shall be so located that discharged water will not interfere with normal conduct of business in building. Concrete splash guards shall be provided at grade level beneath all outside drains to minimize soil erosion.

I. Make screwed joints with pipe compound applied to male threads only. All cut ends of the pipe shall be carefully reamed to full size. U.L. approved flexible couplings are permitted on all feed mains and standpipe risers.

J. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visits.)

K. All piping and equipment shall be furnished and installed in a manner and in locations avoiding all obstructions and maintaining required head room clearances. Field check before start of any installation.

L. Coordinate locations of all piping with lighting fixtures, columns, and other possible obstructions.

M. The contractor is ultimately responsible for:

1. Maintaining all components of the fire protection system free and clear of all dirt, debris, or other potential obstructions.

2. Not storing materials directly on the ground.

3. Making sure that the open ends of piping are plugged or capped during the construction to prevent dirt or debris from entering the pipe where pipes, fittings, and equipment are located in areas subject to dirt or debris.

4. Using methods that prevent damage, deterioration, and other loss during shipping and on-site storage. These include: using padded or strap slings, etc. as appropriate for materials being handled, lifting equipment by lift points provided or recommended by the manufacturer, and storing equipment away from the effects of rain, wind-driven dust, and other similar phenomena.

N. Provide at the base of each riser a placard of 1/8 inch thick, red laminated phenolic material indicating the following design criteria:

1. Design area and density served by stand pipe.

2. Required flow and pressure

3. Allowance for hose streams

3.2 FIRE DEPARTMENT CONNECTIONS

A. Locate the FDC such that sufficient clearance from all walls, obstructions, or other equipment is provided to allow full swing of the fire department wrench handle.

B. The FDC shall be mounted at least 18 inches above pavement, sidewalks or grade adjacent to the exterior of the building.

3.3 VALVE INSTALLATION

A. Install fire-protection valves, trim, fittings, controls, and specialties according to NFPA 13, manufacturer's written instructions, and the AHJ.

B. All valves installed in horizontal lines shall be installed with the stems horizontal or above. Valve handwheels shall be oriented, when installed, to provide maximum accessibility for operation.

3.4 DEMONSTRATION AND TRAINING

A. Coordinate with section 21 01 00.

B. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information. Provide two 2-hour training sessions.

C. Schedule demonstration with Owner. Allow at least 21 days advance notice.

END OF SECTION 21 10 00

SECTION 22 03 00 – PLUMBING BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDES

Pipe
Fittings
Valves
Strainers
Unions
Pressure Gauges
Floor, Ceiling and Wall Plates
Sleeves
Inserts, Hangers and Supports
Nameplates, Markers and Tags
General Installation Requirements
Access to Equipment and Devices
General Piping
Sanitary and Storm Drainage Systems
Domestic Water Supply System
Cleaning and Disinfecting
Tests and Adjustments
System and Equipment Identification

1.2 SUBMITTALS

A. Refer to Section 22 01 00.

1.3 CONSTRUCTION DOCUMENTATION

A. Refer to Section 22 01 00.

B. Submit pipe pressure test and disinfection documentation upon completion of testing and disinfecting. Include final copies in the Operating and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 PIPED SYSTEMS

A. Application schedule of required pipe materials and joining:

PIPE AND JOINING APPLICATION SCHEDULE			
PIPED SYSTEM	**PIPE SIZE RANGE**	**PIPE SPECIFIED TYPE (s)**	**JOINING SPECIFIED METHOD(s)**
Domestic Water Underground Service	2" and smaller	Cu-K-soft	"Without joints"
Domestic Water Underground Service	3" and larger	DI-WS	Push Joint
Domestic Water Inside Building	2" and smaller	Cu-L	Soldered, or Pressed fitting system

Domestic Water Inside Building	2-1/2" to 4"	Cu-L	Brazed, Pressed fitting system, or Grooved Joining system
Domestic Water Inside Building (NOT in HVAC Plenums)	2-1/2" to 6"	CPVC sch80	Solvent Weld
Domestic Water Inside Building (NOT in HVAC Plenums)	2" and smaller	PVC sch80	Solvent Weld
Domestic Water Inside Building (NOT in HVAC Plenums)	2-1/2" to 4"	PVC sch80	Solvent Weld
Sanitary Drainage, Waste and Vent Piping -Underground	2" to 15"	CI-SW	Push Joint
Sanitary Drainage, Waste and Vent Piping - Above Ground	1-1/2" to 15"	CI-NH	No-Hub coupling, or MG fitting
Sanitary Drainage, Waste and Vent Piping -Underground	2" to 15"	PVC-DWV	Solvent Weld
Sanitary Drainage, Waste and Vent Piping - Above Ground (Not in HVAC Plenums)	1-1/2" to 15"	PVC-DWV	Solvent Weld
Storm Drainage Piping - Underground	3" to 15"	CI-SW	Push Joint
Storm Drainage Piping - Above Ground	3" to 15"	CI-NH	No-Hub coupling, or MG fitting

2.2 PIPE AND FITTING SPECIFICATIONS

A. CI-NH: No hub cast iron pipe and fittings (ASTM A888, CISPI-301), as manufactured by Charlotte, Tyler, or AB + I.

B. CI-SW: Service weight cast iron, bell and spigot, soil pipe, and fittings (ASTM A74, ASTM A888, CISPI-301) as manufactured by Charlotte, Tyler, or AB + I. push joint seals of neoprene pipe gaskets (ASTM C564).

C. CPVC sch80: Schedule 80 Chlorinated Polyvinyl Chloride (CPVC) pipe and fittings (ASTM D 2846) (ASTM F441), 210 degree F temperature limit. CPVC fittings meeting ASTM F439, with solvent-weld socket type ends for schedule 80 pipe. For connections to equipment, outlets and valves requiring threaded connections conform to ASTM F437. For flanged connections use one or two piece flanges meeting ANSI B16.5, Class 150.

D. Cu-K-soft: Type "K" soft copper tube without joints (ASTM B88).

E. Cu-L: Type "L" hard drawn seamless copper tube (ASTM B88). Fittings for copper pipe - wrought copper solder joint type (ASME B16.22). Where silver brazing alloy is used to join pipe and fittings, fittings to be suitable for brazing (ASME B16.50).

F. DI-WS: As required by the serving utility but not less than ANSI A21.51/AWWA C151 cement mortar lined (ANSI A21.4/AWWA C104) ductile iron pipe. Furnish with rubber gasketed push on joints (ANSI A21.1/AWWA C111) Fittings in vault- (ANSI A21.10/AWWA A153).

G. PVC-DWV: Schedule 40 PVC solid core DWV pipe and fittings per ASTM D2665 with solvent-weld socket fittings for schedule 40 pipe. Acceptable manufacturers: Atkore, Charlotte Pipe, JM Eagle, Lasco, North American Pipe Corporation, or Spears.

H. PVC sch80: Schedule 80 PVC pressure piping (ASTM D1785) and fittings of unplasticized PVC, normal impact Type 1, (ASTM D2467), with solvent-weld socket type ends for schedule 80 pipe. For connections to equipment, outlets and valves requiring threaded connections, use solvent-weld socket to threaded joint adapters and unions, or schedule 80 threaded PVC pipe.

2.3 PIPE JOINING SYSTEMS

A. Grooved Piping Systems: Where listed for acceptable joining method in above application schedule, the following grooved piping systems may be used for pipe sizes 2-1/2" and larger, for domestic water piping systems.

1. Grooved Piping Systems (Domestic Water)

a. Piping: 2-1/2 inches through 6 inches – Type L hard drawn copper tubing ASTM B88 roll grooved. Gaskets: Grade E, EPDM, FlushSeal (for copper tubing), green color stripe, temperature range minus 30 degrees F to 230 degrees F. (Grade E gaskets UL classified in accordance with ASNI/NSF-61 for potable water service.)

b. Pipe Couplings:

1) Copper Tubing: Rigid type, consisting of two pieces of ductile iron, cast with offsetting, angle-pattern bolt pads to copper-tube dimensions. Coupling gaskets will be a synthetic rubber EPDM gasket with a FlushSeal pressure responsive design. Victaulic Quick 607.

c. Fittings:

1) Copper Tubing: Full flow wrought copper or cast bronze grooved end fittings, ASTM B75 tube or B152 and ASME B16.22. Fittings shall be manufactured to copper tubing sizes.

d. Butterfly Valves (Shutoff Service)

1) Copper Tubing: 2-1/2 inches through 6 inches. Cast bronze body with copper-tubing sized grooved ends. Triple seal type. Designed for bubble tight, shut off service up to 300 PSI, maximum temperature rating 230 deg F. Furnish with lever lock handle. Victaulic Series 608.
2) Installation must be in accordance to manufacturer's instructions and specifications.

e. Manufacturer: Victaulic Company of America, equivalent by Anvil International, Inc. – Gruvlock, Grinnell Mechanical Products.

B. Copper Press System: Where listed for acceptable joining method in above application schedule, the following press system may be used.

1. Press Fittings: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM.

2. Installation must be in accordance to manufacturer's instructions and specifications.

3. Manufacturer: Viega Pro-Press or equivalent by Nibco, or Apollo.

2.4 VALVES

A. Provide all valves of the same manufacturer where possible.

B. Valves shall be "Lead Free": Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th 2011 Section1417.

C. All valves to be of domestic manufacture.

D. Manufacturers: valve basis of design are of NIBCO manufacture. Other acceptable manufactures

1. Apollo

2. Milwaukee

3. Watts

E. Provide valves with joining ends to match that of the specified piped system(s).

F. Utilize adapter fittings only when listed valve manufacturer does not offer suitable ends for joining to the specified piped system's joining.

G. Valves in water piping 2 inches and smaller: two-piece ball valves with cast silicon bronze body, Teflon seats, full port, blow-out proof stem, adjustable packing gland, stainless steel or silicon bronze ball, soldered, Press or threaded ends, minimum 150 WSP, 600 WOG. Provide thermoplastic extended handle for 2" of insulation. Conform to ASTM, NIBCO 585-80 or -66-LF-NS Series.

H. Valves in water piping 2-1/2 inches and larger: butterfly type, Class B Ductile iron body, stainless steel stem, aluminum bronze disc, and EPDM liner; 200 PISG WOG. Lug type with lug drilled and tapped, extended neck. Operators: on-off, 10 position, throttling lever handles on sizes 2-1/2 inches to 6 inches, totally enclosed worm gear or Acme screw operators with hand wheel on sizes 8 inches to 20 inches. Equip valves used for balancing with memory stop. NIBCO LD2000 Series

I. Horizontal check valves 2 inches and smaller: swing type design, Class 125, 200 WOG, with silicon bronze body and cap with threaded, Press or soldered ends. Conform to ASTM. NIBCO 413-LF

J. Horizontal check valves 2-1/2 inches and larger: swing type design, Class 150, 200 WOG, Ductile iron body, flanged ends, Stainless Steel trim and bolted cap conforming to ASTM A126, Class B. NIBCO F-938-33

K. Vertical check valves 2 inches and smaller: 250 WOG. Center guided, silent, non-slam type. Bronze body, spring, and disc holder, threaded ends. NIBCO 480-Y-LF

L. Vertical check valves 2-1/2 inches and larger: 125 pound flanged ends, wafer style, silent type, cast iron body, with silicon bronze trim, stainless steel spring. NIBCO F-910-B

M. Valves for use in Grooved Piping Systems: Refer to Grooved Piping System specification.

N. Other valves or valve requirements are specified in the Sections applicable to the various systems.

2.5 STRAINERS

A. 2 inches and smaller, 'Y' type pipe line strainer, brass or bronze body, threaded ends, 304 stainless steel screen with 20 mesh openings, 400 PSIG at 210 degree F. Complete with solid retainer cap and gasket. WATTS Series 777 or equivalent by CLA-VAL, Conbraco, Febco, or Wilkins.

B. 2-1/2 inches and larger 'Y' pattern pipeline strainer, NSF and FDA approved epoxy coated iron body, 125 pound flanged ends, bolted cover, 200 PSIG water, oil, gas operating pressure, and of # 304 stainless steel screen. Complete with blow down connection with closure plug. WATTS Series 77F-DI-FDA-125 or equivalent by CLA-VAL, Conbraco, Febco, or Wilkins.

2.6 UNIONS

A. Unions in steel piping 2 inches and smaller, malleable iron, ground joint brass to iron seat suitable for 175 PSI working pressures.

B. Unions in copper piping 2 inches and smaller, cast brass solder fittings with machined and lapped seats suitable for 175 PSI working pressures.

C. Unions on all piping 2-1/2 inches and larger: Use flanged connections. Gaskets used with flanged fittings: 1/16 inch thick, ring type, compressed graphite sheet.

D. Where grooved joint piping systems are utilized, unions are not required. Couplings shall serve as unions.

2.7 DIELECTRIC CONNECTIONS

A. Provide at connections between copper and ferrous metal piping materials in domestic cold water systems ASTM F441, Schedule 80, CPVC threaded pipe nipples, 4 inches minimum length. Provide for dielectric connections in pipe sizes 2 inches and smaller.

B. Provide at connections between copper and ferrous piping in domestic hot water systems Victaulic Clearflow dielectric waterway Style 47. Fitting consists of zinc plated casing with a chemically inert NSF/FDA listed dielectric thermoplastic lining.

2.8 PRESSURE GAUGES

A. Provide a gauge at the domestic water entry after the backflow preventer.

B. Provide gauges having proper ranges as required by conditions. Gauges to have 4-1/2 inch diameter dials, cocks, snubbers, and siphons.

C. Select scale ranges so pressure condition will fall approximately at mid-scale.

D. Manufacturer: Trerice or equivalent by American Consolidated, Marsh or Ashcroft.

2.9 FLOOR, CEILING, AND WALL PLATES

A. Fit all pipe passing exposed through walls, floors, or ceilings in finished rooms with steel or brass escutcheons. Where surface is to receive a paint finish make escutcheons prime painted; otherwise make escutcheons nickel or chrome plated. Where piping is insulated, fit escutcheons outside insulation.

2.10 SLEEVES

A. Where pipes pass through masonry or concrete walls, set machine cut steel pipe sleeves 1 inch larger than outside diameter of pipe, with ends of sleeves flush with wall faces. Sleeves in partitions other than masonry or concrete where firestopping is required: 28 gage galvanized steel sheet.

B. Where pipes pass through floors, set Schedule 40 galvanized steel pipe sleeves 1 inch larger than the outside diameter of the pipe. Top of sleeve to be 4 inches above finished floor in machine rooms and wet floor locations.

C. Where pipes are insulated, provide sleeves large enough to allow insulation to pass through sleeve. Center pipes in sleeves.

D. Set sleeves true to line, grade; position and plumb or level and so maintain throughout construction period.

E. Where concrete or masonry walls are core drilled for pipe passage steel sleeves are not required.

2.11 INSERTS, HANGERS, AND SUPPORTS

A. Manufacturer: Basis of design shall be Anvil. Other acceptable manufacturers include Mason, Holdrite, or Erico/Caddy.

B. Provide all inserts, hangers, anchors, guides, sway bracing, restraints, and supports to properly support and retain piping, conduits and equipment; to control expansion, contraction, anchorage, drainage and prevent sway and vibration.

C. Provide inserts for support of work in concrete construction.

D. Provide supplementary angles, channels, and plates where supports are required between building structural members, span the space and attach to building structural members by welding, bolting or anchors.

E. Provide hangers, rollers, threaded rods, turnbuckles, saddles, insulation protectors, anchors, and all other miscellaneous specialties for the attachment of hangers and supports to structure.

1. For up to 3/4 inch diameter rod: Anvil Figure 92, 93, or 94 beam clamps.

2. For 7/8 inch and 1 inch diameter rod: Anvil Figure 134 beam clamp with Anvil Figure 290 eyenut.

3. Pressed steel beam clamps are not permitted.

F. Provide rods, angles, rails, struts, brace plates, and platforms required for suspension or support of piping, conduit and equipment.

G. Support individual piping from hangers as follows:

1. Uninsulated piping 2 inches and smaller - Anvil Figure #69 adjustable swivel ring.

2. Uninsulated piping 2-1/2 inches and larger - Anvil Figure 260, Carbon Steel adjustable wrot clevis type.

3. Copper tubing (uninsulated) - Anvil Figure CT-69 carbon steel ring and malleable iron adjusting nut completely copper plated.

4. Insulated piping 2 inches and smaller - 18 gage galvanized steel shield (Anvil Figure 167) over insulation in 180 degree segments, minimum 12 inches long with Anvil Figure 260 adjustable clevis type hanger. Or option of using Insulation Saddle System by ANVIL, Figure. #260ISS. ASTM A36 Carbon Steel Clevis Hanger with V-Block Hi Impact Glass reinforced Polypropylene Saddle with low thermal conductivity of .77 (BTU-Sq.Ft. – Hr-Deg F), Flammability Rating Dual Listed ASTM E84 and V-0 UL 94, and Carbon Steel Spacer.

5. Insulated piping 2-1/2 inches and larger (except cold piping) - Anvil Figure 260 adjustable clevis type hanger with pipe covering protection saddle or Anvil Figure 160 Series (depending on insulation thickness). Or option of using Insulation Saddle System by ANVIL, Figure. #260ISS. ASTM A36 Carbon Steel Clevis Hanger with V-Block Hi Impact Glass reinforced Polypropylene Saddle with low thermal conductivity of .77 (BTU-Sq.Ft. – Hr-Deg F), Flammability Rating Dual Listed ASTM E84 and V-0 UL 94, and Carbon Steel Spacer.

6. Rollers - Where thermal movement causes a hanger rod to deviate more than five degrees from the vertical or where longitudinal expansion may cause a movement of more than 1/2 inch in the piping, use and install roller hangers or chairs, Anvil Figure 181, 171, or 175.

7. Plastic piping systems: 18 gauge galvanized steel shield (Anvil Figure 168) over 180 degrees of bottom of pipe, length as recommended by manufacturer. Use with Anvil

Figure 260 adjustable clevis type hanger.

H. Hanger Spacing (Steel Pipe)

PIPE SIZE	MAXIMUM SPACING	MINIMUM ROD DIAMETER
Up to 1"	6'	3/8"
1-1/4"	8'	3/8"
1-1/2", 2"	10'	3/8"
2-1/2", 3"	12'	1/2"
4", 5"	12'	5/8"
6"	12'	3/4"
8"	12'	3/4"

I. Provide additional lock nut on each threaded support rod.

J. Provide additional hanger support within two feet of each elbow and at valves, strainers and other equipment in pipe lines.

K. Support copper pipe at intervals of not over 10 feet for 1-1/2 inch and larger, and not over 5 feet for 1-1/4 inch and smaller. Provide additional supports where necessary to maintain proper alignment.

L. Support sanitary drain and vent and storm drain piping at every hub or coupling within 18 inches of hub or coupling. Installations requiring multiple joints within a 4 foot developed length shall be supported at every other or alternating hubs or couplings. Supports shall not exceed 10 feet between hangers. Vertical components shall be secured at each base stack. Provide additional supports where necessary to maintain proper alignment and grade.

M. Hanger Spacing (Plastic Pipe)

PIPE SIZE	MAXIMUM SPACING
Up to 1"	2.5'
1-1/4" to 3"	3'

N. Support vertical pipe risers with friction clamps at least at alternate floors.

O. Trapeze hangers may be used for multiple runs of piping. Construct of a channel with adjustable hanger rods. Determine hanger spacing by the smallest pipe supported. Install all piping free for independent movement on the trapeze hanger. Provide insulation protection saddles as specified for individual pipe support.

P. Do not suspend a pipe from another pipe or ductwork. Do not support ceiling framing or lighting from piping.

Q. Provide support saddles where pipes are insulated. All insulation shall be continuous through all hangers.

R. Secondary Pipe Positioning and Supports:

1. Field devised methods of plumbing pipe support, such as with the use of scrap framing materials, are not allowed. Support and positioning of all secondary piping shall be done by means of engineered methods that comply with IAPMO PS 42-96.

2. Pipe Clamps in Plenum-Rated Environments: All non-metallic clamps must meet ASTM E-84 25/50.

3. Suspended Equipment: Suspended water heaters of 30 gallons or less, suspended from the structure above, shall be installed with an engineered and manufactured product such

as the Suspended Water Heater Platform with integral drain body.

4. Hubless Cast Iron Soil Pipe Restraints: CISPI 310-11 complainant engineered restraints comprised of 16 GA, CRS, Galvanized straps and/or heavy duty black steel or galvanized pipe clamps with stainless steel bands, and galvanized steel hardware.

5. Manufacturer: Hubbard Holdrite or equivalent by Erico/Caddy, or Sioux Chief.

2.12 NAMEPLATES, MARKERS AND TAGS

A. Equipment Nameplates

1. Equipment nameplates shall be laminated phenolic with a black surface and white core. Use 1/16 inch thick material for plates up to 2 inch by 4 inch. For larger sizes use 1/8 inch thick material.

2. Lettering shall be condensed Gothic. The space between lines shall be equal to the width of the letters. Use ¼ inch minimum height letters which occupy four to the inch.

3. Nameplates shall be attached to equipment with brass screws or rivets; no adhesive attachments will be permitted.

4. Acceptable Manufacturers: Seton Nameplate Company, Marking Services Inc.

B. Valve Tags

1. Tags shall be 2" diameter, 1/16" thick, multilayered acrylic with engraved letters.

2. Lettering shall be ¾" high for type service and ½" for number. Tag shall indicate service and valve number. Letter and number designations shall be coordinated with the Owner.

3. Each service shall be a different color in conformance with the "Scheme for the Identifications of Piping Systems" (ANSI/ASME A13.1).

4. Tag shall be attached with chain similar to Seton No. 16 stainless steel jack chain. Use of beaded chain or wire is not acceptable.

5. Acceptable Manufacturers: Seton Nameplate Company, Marking Services Inc.

C. Pipe Markers

1. Each marker background shall be appropriately color coded with a clearly printed legend to identify the contents of the pipe in conformance with the "Scheme for the Identifications of Piping Systems" (ANSI/ASME A13.1).

2. Flow direction arrows shall be included on each marker.

3. Snap-around markers shall be used for overall diameters up to 6" and strap-around markers shall be used above 6" overall diameters.

4. Acceptable Manufacturers: Seton Nameplate Company, Marking Services Inc.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Location of piping, equipment, etc., on the drawings are diagrammatic; indicated positions shall be followed as closely as possible, exact locations shall be subject to building construction and

interferences with other work. In general, conceal piping located outside of equipment rooms. Difficulties preventing the installation of any part of work as indicated, shall be called to the attention of the Architect. Architect will determine locations and changes. Contractor shall install the work accordingly. Architect reserves right to make minor changes in location of any part of the work up to the time of roughing-in without additional cost.

B. Install all materials and equipment in a neat and workmanlike manner by competent specialist for each subtrade. The installation of any materials and equipment not meeting these standards may require removal and reinstallation at no additional cost to the Owner.

C. Locate piping and other services, in pipe spaces, to ensure maximum accessibility. Where necessary to cross pipe spaces, crossing must be made near the floor or 6 feet or more above floor.

D. Install, connect equipment, services, materials according to best engineering practice and in conformity with manufacturer's printed instructions. Provide complete auxiliary piping, water seals, valves, electric connections, controls, etc., as recommended by respective equipment manufacturer or required for proper operation.

E. Take all measurements and determine all elevations at the building.

3.2 ACCESS TO EQUIPMENT AND DEVICES

A. All valves, equipment, and other devices requiring examination, adjustment, service, and maintenance shall be accessible. If located above drywall ceiling or behind finished walls, provide an access door. Coordinate all access door locations with the Architect and General Trades.

B. To ensure accessibility during and after construction, when a device is installed, its location shall be marked with securely attached temporary signage. Signage shall indicate the amount of clearance required for the specific device. Signage shall remain in place until the ceiling or access door is installed or until substantial completion.

C. Clearance shall include not only code required clearance but also clearance for Owner's staff to access the device. This access shall be from the floor or from the floor level using normal maintenance ladders and apparatus to meet all OSHA requirements. Consideration shall be given to accessing a device through an access door.

D. Where a device is installed above finished ceilings, signage shall be hung below the device at the finished ceiling level. Where a device is exposed, in open ceiling areas, signage shall be hung at approximately 8' above the floor level.

E. Plumbing Contractor shall monitor these access locations until substantial completion and notify Architect, Owner and Engineer when the access area is encroached upon so that corrective action may be taken immediately.

F. Corrective action shall be the responsibility of the trade encroaching the access area unless identified that the equipment in question is installed incorrectly.

3.3 GENERAL PIPING

A. Drawings (floor plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

C. Install all valves and equipment with unions or flanges or grooved couplings to facilitate removal.

D. Provide hose end drain valves with cap at all low points, trapped sections and on equipment side of all branch valves to permit draining of all or part of liquid piping systems.

E. Locate covered piping a sufficient distance from walls, other pipe, ductwork, or other obstacles, to permit application of the full thickness of insulation specified; if necessary, use extra fittings and pipe.

F. Use Dielectric Connectors where pipe materials change from ferrous to copper.

G. Make piping connections to equipment and fixtures indicated.

H. Plug open ends of pipe or equipment at all times during installation to keep dirt and foreign material out of system.

I. Arrange and install all pipes, valves, cleanouts, access openings and equipment so as to be accessible for service. Locate equipment to maintain clearances for tube pulling, periodic servicing.

J. Unless otherwise specified, make branch connections in welded steel piping less than 2/3 of main size with weldolets, butt, or threaded type. Make branch connections 2/3 of main size and larger with weld tees, laterals, or crosses. Shaped nipples are not acceptable.

K. Make reductions in piping lines with reducing coupling.

L. Support piping so as not to place a strain on valves or equipment.

M. Install Grooved Piping System according to manufacturer's recommendations.

1. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

2. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.

N. Install Copper Press System according to manufacturer's recommendations.

1. Pipe shall be fully inserted into the fitting and pipe marked at the shoulder of the fittings.

2. The fitting alignment shall be checked against the mark on the pipe to assure the pipe is fully engaged (inserted) into the fitting.

3. Joint shall be pressed using the tool provided by the manufacturer.

3.4 JOINTS

A. Joint methods shall be as previously specified in this section for the respective piped systems.

B. All pipes must be reamed and cleaned before assembly. Apply pipe compound to male end of threaded joints. Make all welded joints as previously specified.

C. Make joints in above ground no-hub cast iron pipe systems for storm drain, sanitary, waste, vent and drain piping with engineered couplings comprised of rubber/elastomeric ribbed or grooved gasket, stainless steel shield band, and multiple stainless steel clamping comprised of either 1/4, 5/16, or 3/8 inch drives. The following coupling application indicates duty classes and shall be the minimum required for the project. The contractor may option to exceed the minimums to

utilize one clamp for the entire project at no extra cost.

1. Joints located in systems with less than 50 feet of elevation above.

   a. For sizes through 2 inches, provide standard duty, CISPI 310 compliant as manufactured by Tyler, Anaco, Ideal, Clamp-All Corporation, or Husky.
   b. For sizes 2-1/2 inches and larger, provide 80 inch pound torque hubless soil pipe couplings. Provide Clamp-All Corporation Model 80, Husky Series 2000, Ideal MD, or Mission HW coupling conforming to FM1680 class one and ASTM C1540.

2. Joints located in systems with greater than 50 feet of elevation above.

   a. For sizes through 2 inches, provide 80 inch pound torque hubless soil pipe couplings. Provide Clamp-All Corporation Model 80 or Husky Series 4000, Ideal HD, Mission HW, or MG coupling conforming to FM1680 class one and ASTM C1540, or MG coupling.
   b. For sizes 2-1/2 inches and larger, provide heavy duty 120 inch pound torque hubless soil pipe couplings manufactured by Clamp-All Corporation Model 125, Ideal HD, conforming to FM1680 class one and ASTM C1540, or MG coupling.

D. Provide code required CISPI 310-11 complainant anchorage and restraints in cast iron hubless piping system for 5 inch in size and greater.

E. Make solvent welded joints in PVC and CPVC piping with compatible solvents and/or cleaning chemical specified by manufacturer of the particular brand piping being installed. Contractor shall be responsible for safeguarding against incompatible solvents and cleaners

F. Make push-on joints in underground PVC piping with elastomeric gaskets meeting ASTM F477.

G. Make joints in underground cast iron soil, waste, vent and drain piping with hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets.

3.5 EXPANSION

A. Install all piping throughout the project with adequate allowance for expansion to prevent damage to building, equipment, and piping. Provide anchors, loops, expansion compensators, or expansion joints for complete control of movement.

1. Make changes in directions with fittings.

2. Bullhead connections in any piping service are prohibited.

3.6 SANITARY AND STORM DRAINAGE SYSTEMS

A. Run all drainage and vent piping as direct as possible. Install drains, soil, waste, and storm piping in an actual location to meet the various building conditions. Do any work necessary to conceal piping or clear piping and ductwork of other trades.

B. Slope branch soil, waste and storm pipes at an incline of at least 1/4 inch per foot of run, and main house drain and storm drain at 1/8 inch per foot unless noted otherwise. Make changes in direction of drainage piping by means of "Y" branches and 1/4, 1/8 or 1/16 bends except that sanitary 'T's and crosses may be used on vertical stacks. Make no unnecessary bends or offsets, where changes in direction are unavoidable make with bends of not more than 45 degrees.

C. Provide cleanouts at base of all stacks and downspouts, at changes of direction and as indicated. Where more than one change of direction occurs in a run, only one cleanout is required for each 40 feet of developed length of drainage piping. Extend cleanouts on underground lines flush with finished floor or grade. Provide cleanouts not over 50 feet on

center along straight runs. Install cleanouts same size of pipe up to 4 inch in diameter. Provide pipe over 4 inch in diameter with a 4 inch cleanout. All cleanouts shall be accessible.

D. Lay all storm and sanitary sewers with full length of each section resting on a solid bed. Lay pipe starting at upgrade with spigot end of pipe pointing in directions of flow.

E. Provide engineered no-hub joint restraints for hubless cast iron piping greater than 4 inch in size in accordance with the CISPI installation at changes in direction and at changes in pipe size of two or more in accordance with the CISPI installation handbook.

3.7 DOMESTIC WATER SUPPLY SYSTEM

A. Install new water service from the street main. Install water meter reduced pressure backflow preventer. Provide underground valve and meter vault per local Water Department regulations.

B. Install water system as indicated with hot and cold water being supplied and connected to all fixtures and equipment.

C. Connect to the site water main at a point 5'-0" outside of the building.

D. Pitch all water piping to drainage points, provide hose end drain valves at such points.

E. Provide trap primer and domestic water piping to trap primer for all floor drains.

F. Provide pressure gauge with shutoff cock on cold water service line inside building.

G. Provide reduced pressure back flow preventers and install where indicated.

H. Provide strainers upstream of the building's water service backflow preventers, and as indicated elsewhere.

I. Provide unions at all equipment valves, strainers, etc., to facilitate removal for repair or replacement without disturbing adjacent piping.

3.8 CLEANING AND DISINFECTING

A. Flush and disinfect all newly installed and or repaired potable water piping systems prior to utilization as required by the plumbing code.

B. Chlorination procedures shall conform that prescribed by the local health department or water purveyor having jurisdiction. In absence of such, procedures described in AWWA Specification C651 or AWWA C652, or that listed in the plumbing code itself shall be acceptable.

C. All flushing and chlorination shall be fully documented and submitted by the plumbing contractor. Include documentation and sample test reports in the Operating and Maintenance Manual.

D. After initial period of operation clean all strainers, and dirt legs.

3.9 TESTS AND ADJUSTMENTS

A. Obtain all inspections required by law, ordinances, rules, regulations of authorities having jurisdiction, furnish certificates of such inspections. Pay all fees, and provide all equipment, power and labor necessary for inspections and tests.

B. During testing period maintain on the project an engineer thoroughly familiar with all phases for as long a period as required to thoroughly adjust all systems and demonstrate that they are functioning properly.

C. Perform all tests, including but not limited to those specified, make necessary adjustments to obtain specified equipment and system characteristics.

D. Do not consider work under this Specification complete until required inspections have been obtained, tests performed, necessary adjustments made and satisfactory evidence of compliance has been submitted. Architect reserves right to make spot checks to determine accuracy and completeness of final adjustments.

E. Piping Pressure Tests:

1. All piping shall be given the following pressure test without pressure drop. Equipment which would be damaged by the required test pressure shall be isolated from the system during test.

SERVICE	MEDIUM	(PSI)	HRS.
Underground Water	Water	125	*
Domestic Water	Water	125	6

* AWWA Procedures

Sanitary and storm sewers per State Plumbing Code or Local Authority

2. Correct minor leaks in welded joints by chipping out weld and re-welding. Correct leaks in screwed joints by replacing thread or fitting or both. Caulking of threaded joints is not permitted. Repair leaks in copper tubing by sweating out joints, thoroughly cleaning both tube and fitting, and resoldering.

3. Perform all tests before piping is concealed or covered.

4. Be responsible for completely draining the systems after hydrostatic tests are performed. Any damage from freezing prior to acceptance of the completed installation shall be repaired at no additional cost to the Owner.

5. All tests shall be scheduled and documented. Include copy of the piping system pressure test reports in the Operating and Maintenance Manual.

3.10 SYSTEM AND EQUIPMENT IDENTIFICATION

A. Valve Identification

1. Identify all valves with tags attached with chain. Local valves need not be tagged. All valves shall be designated by distinguishing numbers and letters carefully coordinated with a valve directory. All letter and number designations shall be coordinated with the Owner.

2. Designations and locations shall be accurately recorded on the Record Drawings.

3. At completion of project, provide a framed valve directory, under Plexiglass, giving number of valve, service, building location by column coordinates, floor location, manufacturer's figure number, size, and equipment controlled. For service, use designation shown in legend on drawings. Mount where directed by Owner.

B. Valve Data Base.

1. Provide a valve data base for all valves to operate on the building computer.

2. Every valve shall include.

a. Tag Number
b. Service (Domestic Cold Water, Domestic Hot Water, etc.)
c. Size
d. Operation
e. Location
f. Manufacturer
g. Model Number
h. Submittal Reference

C. Pipe Markers

1. Identify pipe throughout the building, including in equipment rooms.

2. Markers shall be located:

a. Adjacent to each valve.
b. At each branch.
c. At each cap for future.
d. At each riser takeoff.
e. At each pipe passage through wall (each side).
f. At each pipe passage 20' – 0" intervals maximum.
g. At each piece of equipment.
h. At all access doors.
i. A minimum of one (1) marker shall be provided at each room.

END OF SECTION 22 03 00

SECTION 22 07 00 – PLUMBING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDES

A. All labor, equipment, accessories, materials and services required to provide insulation systems for piping and related equipment in the plumbing systems.

1.2 SUBMITTALS

A. Refer to Section 22 01 00.

1.3 QUALITY ASSURANCE

A. The Insulation Contractor shall be regularly engaged in the installation of insulation systems and shall have a minimum of five (5) years of demonstrated experience in the installation of insulation systems similar in type and size.

B. Install insulation materials and accessories in accordance with the manufacturer's published instructions, recognized industry standards and this specification to ensure that it will serve its intended purpose.

PART 2 - PRODUCTS

2.1 GENERAL

A. Insulation material, performance and thickness shall comply with ASHRAE 90.1 – 2010 requirements.

B. Insulation material (insulation, jackets, fitting covers, tapes, adhesives, cements, mastics, sealants, coatings and finishes) shall have a composite Fire and Smoke Hazard rating as tested under procedure ASTM E-84 or UL 723, not exceeding the following:

1. Flame Spread 25

2. Smoke Developed 50

C. Mastics, cements, coatings, adhesives, sealants and finishes shall be suitable for contact with the surface material for which it is applied to and rated for the working temperature of the service. All adhesives and sealants wet applied on site shall comply with chemical content requirements of the South Coastal Air Quality Management District (SCAQMQ) Rule 1168. Acceptable Manufacturers: Foster Products, Childers Products and Vimasco Corporation.

2.2 PIPE INSULATION

A. Insulation Types:

1. Fiberglass: Owens-Corning SSL II-ASJ one piece fiberglass pipe insulation with All Service Jacket and double adhesive longitudinal lap seal. Furnish as a complete system with pressure sensitive butt strip seals having factory applied adhesives. Other acceptable manufacturers: Knauf and Johns Manville.

B. Pipe Insulation Material Schedule

Note: refer to Insulation Thickness Schedule.

PIPE INSULATION APPLICATION SCHEDULE		
Service	Type	Thickness
Cold Water	Fiberglass	A
Hot Water	Fiberglass	B

C. Insulation Thickness Schedule (inches)

Thickness Schedule Type	PIPE SIZES (INCHES)				
	3/4 and below	1 to 1-1/4	1-1/2 to 3	4 to 6	8 and above
A	1/2	1/2	1	1	1
B	1	1	1-1/2	1-1/2	1-1/2

PART 3 - EXECUTION

3.1 GENERAL

A. Install insulation products according to manufacturer's published instructions, this specification and recognized industry standards to ensure it will serve its intended purpose.

B. Protect insulation stored on site and during delivery from damage and moisture such as rainwater and building system leaks.

C. Ensure that insulation is clean, dry, and in good mechanical condition and that all factory-applied facings are intact and undamaged. Wet, dirty, or damaged insulation is not acceptable for installation

D. Install insulation over clean dry surfaces.

E. Install insulation subsequent to painting, pressure testing and installation of freeze protection or temperature maintenance cable.

F. Install insulation materials with smooth and even surfaces. Rework poorly fitted joints. Do not use joint sealer or mastic as filler for joint gaps or excessive voids resulting from poor workmanship.

G. Once in place, all tape shall be sealed with a squeegee type device provided by the Manufacturer.

3.2 PIPE INSULATION

A. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.

B. Install insulation continuous through all sleeves and all wall, floor and ceiling penetrations. Sleeves and penetration openings shall be sized accordingly to allow application of full thickness insulation. Coordinate requirements with wall, floor and ceiling construction.

C. On exposed piping, locate insulation and cover seams in least visible locations.

D. Cover exposed fiberglass pipe insulation located in mechanical rooms with PVC Jacket System. System to include straight runs, fittings, valves, flanges, etc.

E. Seal fiberglass pipe insulation longitudinal seams with integral lap seal and butt joints with butt strips. Taper all insulation ends, seal and cover with glass cloth. Insulate valve bodies, fittings, strainer bodies and flanges using premolded fiberglass inserts with PVC Fitting Covers.

F. Install insulation continuous through all pipe hanger locations with circumferential insulation joint made outside the hanger. Piping shall be supported in such a manner that the insulation is not compromised by the hanger or the effects of the hanger. Include hanger accessories as follows:

1. Piping 2" and smaller – to protect against compression, provide insulation protection shields for fiberglass insulation and pre-insulated pipe hanger supports for closed-cell insulation.

2. Cold water piping and piping with a possibility of condensation (2-1/2 inches and larger) – provide thermal break between piping and hanger by use of an insulation protection shield with polyisocyanurate hard block insulation, capable of supporting the weight of the filled piping system. Polyisocyanurate insulation thickness shall match the adjacent pipe insulation thickness.

3. Other piping 2-1/2 inches and larger – provide pipe covering protection saddle.

G. Do not cover valve bonnets, unions and strainer cleanouts with insulation on hot water systems where there is no possibility of condensation.

H. Provide aluminum jacketing system for fiberglass pipe insulation installed outdoors. Install per Manufacturer's recommendations to ensure a continuous weatherproof system.

I. Coordinate insulation pipe size requirements for piping equipped with freeze protection or temperature maintenance cable with the installed pipe sizes. For piping 1-1/4 inch and below, insulation pipe size shall be ¼ inch larger than pipe size to allow adequate space for the cable.

3.3 FIELD QUALITY ASSURANCE

A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be accomplished while work is in progress to assure compliance with requirements to cover and protect insulation materials during installation.

3.4 PROTECTION

A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.

B. Maintain the integrity of factory-applied vapor barrier jacketing on all insulation, protecting it against puncture, tears or other damage.

C. The insulation installer shall advise all other trades as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

END OF SECTION 22 07 00

SECTION 22 10 00 - PLUMBING SYSTEM COMPONENTS

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Plumbing Water Supply Specialties

1. Hose Bibbs

2. Backflow Preventers

3. Water Meters

4. Trap Primers

5. Trap Seals

B. Plumbing Drainage Specialties

1. Cleanouts

2. Floor Drains

3. Parking Garage Deck Drains

1.2 SUBMITTALS

A. Refer to Section 22 01 00.

PART 2 - PRODUCTS

2.1 PLUMBING WATER SUPPLY SPECIALTIES

A. Hose Bibbs:

1. Manufacturer: Hose Bibbs indicated are Chicago Faucet and Woodford. Other acceptable manufacturers are: T&S Brass and Zurn.

2. Hose Connections: Furnish with garden hose thread outlets conforming to ASME B1.20.7.

B. Backflow Preventers (BFP):

1. Reduced pressure principle type (2 inches and smaller). Conforming to American Society of Sanitary Engineering (ASSE) Standard 1013. Differential relief valve located between two positive seating check valves Bronze body construction with stainless steel internal parts. Supplied with manufacturer's standard strainer. Furnish with manufacturer's standard full port ball valves with resilient seats on inlet and outlet. Furnish with ball type test cocks. Maximum working pressure: 175 psi. Maximum water temperature: 140 degrees F. Watts Regulator Co. Series 909 or equivalent by Cla-Val, Conbraco/Apollo, Wilkins, Febco or Hersey.

2. Reduced pressure principle type (2-1/2 inches and larger). Conforming to American Society of Sanitary Engineering (ASSE) Standard 1013. Reduced pressure zone assembly with two independent torsion spring check modules, a differential relief valve, two shutoff valves, and required torsion spring check modules. Complete with a single housing constructed from 304 (Schedule 40) stainless steel pipe with groove end

connections. Torsion spring checks shall have replaceable elastromer discs. Furnish with ball type test cocks. Maximum working pressure: 175 psi. Maximum water temperature: 110 degrees F. Provide indirect waste and pipe to drain. Watts Regulator Co. Series 957 or equivalent by Cla-Val, Conbraco/Apollo, Wilkins, Febco or Hersey.

Backflow Prevention Device Application Schedule	
Equipment served	**Device type to be installed**
Building domestic potable water service	ASSE 1013 reduced pressure principle BFP
Building's irrigation provision	ASSE 1013 reduced pressure principle BFP

C. Water Meters

1. General Description: The Plumbing Contractor shall provide the building's water service meter. The meter manufacturer, model, calibration requirements, and its installation shall be governed by the local water provider. The meter size shall be similar size as water service as called for on the Drawings.

D. Trap Primers:

1. Trap Primer (Type E) electronic – installed in mechanical spaces not above ceilings): Electronically activated UL listed trap primer device complete with NEMA-1 box with cover, circuit breaker, solenoid valve, air gap fitting, cycle timer with manual override, and distribution unit. Unit requires 115 Volt Power source. Precision Plumbing Products, Inc. Model; Mini-Prime "MP-500" for up to (4) traps within 20 feet distance, or acceptable equivalent.

E. Trap Seals

1. General: barrier type trap seal insert for use with newly installed floor drains and floor sinks of 2 inch through 4 inch in size. Complete with UV resistant ABS frame and silicone or neoprene flapper with flexible sealing ribs. Tested and certified to ASSE 1072 standard and IAPMO listed.

2. Manufacturer: J.R. Smith (Quad Close), or equivalent by Precision Plumbing Products, Inc. (Pro-Drain), Rector-Seal (Sure-Seal), or Mi-Fab (Mi-Gard).

2.2 PLUMBING DRAINAGE SPECIALTIES

A. Cleanouts and Drains Manufacturers.

1. Cast Iron cleanouts, floor drains, and parking garage deck drains indicated are Jay R. Smith. Other acceptable manufacturers:

   a. Jonespec
   b. Josam
   c. Wade
   d. Watts Drainage
   e. Zurn
   f. MIFAB

2. PVC floor drains, floor sinks, and cleanouts manufacturers:

   a. Charlotte
   b. Jay R. Smith
   c. Mifab
   d. Oatey
   e. Spears

f. Zurn

B. Cleanouts:

1. General: All shall be capable of adjustment to match finish surface. Permanently label all cover plates or plugs to match the cleanout service.

2. Floor Cleanouts (CO)

a. Unfinished Floor and Equipment Rooms: Jay R. Smith Figure 4240, Duco cast iron body and frame with round adjustable scoriated cast iron top.

3. Wall Cleanouts: Jay R. Smith Fig 4422, Duco cast iron caulk ferrule with bronze taper thread plug and stainless steel cover.

4. Cleanouts in base of stacks and interior storm downspouts: Jay R. Smith Fig 4510 series complete with tapped brass plug with stainless steel adjustable cover plate.

a. Equivalent versions manufactured by the pipe manufacturer specified for service shall also be acceptable.

5. Cleanout Tees: Jay R. Smith Fig 4505 series in hub or no-hub with 1/2 inch tapped test port with raised plug.

6. Cleanouts in suspended sewers shall match the applicable specified piping in section 22 03 00 with cast iron no-hub blind plug or PVC ferrule with PVC screw plug.

7. Outside cleanouts occurring in paved, slag or cinder areas: Jay R. Smith Series No. 4250 set in a concrete collar flush with grade.

a. Install outside cleanouts occurring in other areas with a vitreous stopper flush with finished grade.

C. Floor Drains:

1. Traps: Where floor drains are specified without integral traps, provide deep seal pattern 'P' traps with trap primer connection. Furnish traps three (3) inches in diameter or less above grade with cleanout plugs.

2. FD-2 (Unfinished Floor and Equipment Rooms): Jay R. Smith Figure 2320. Duco cast iron body and flashing collar with nominal 8" ductile iron grate and slotted sediment bucket, trap primer connection.

D. Parking Garage Deck Drain

1. Jay R. Smith Figure 2624. Duco cast iron shallow body with heavy duty wide flange flashing collar with nominal 14" diameter Ductile iron vandal proof grate and integral strainer.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to section 22 03 00 part 3 Execution in addition to the following.

B. Drawings (floor plans, schematics, and diagrams) indicate the general location and arrangement of equipment. Location and arrangement of equipment takes into consideration pipe connections locations, panel clearance, replacement and service access, and other design considerations. So far as practical, install equipment as indicated or request deviations with

supportive reasoning to the Engineer of record.

3.2 INSTALLATION

A. Provide all drains installed in waterproof slabs with a flashing ring and coordinate elevation with general trades.

B. Install all components per the manufacturer's recommendations and requirements.

END OF SECTION 22 10 00

SECTION 23 81 26 – SPLIT SYSTEM AIR CONDITIONERS

PART 1 - GENERAL

1.1 WORK INCLUDES

Outdoor Condensing Unit
Indoor Wall Mounted Fan Coil Unit

1.2 SUBMITTALS

A. Refer to Section 23 01 00.

1.3 QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (N.E.C.) and local codes as required.

C. The units shall be rated in accordance with AHRI Standard 210 and bear the ARI Certification Label.

D. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

1.4 WARRANTY

A. The units shall have a manufacturer's parts and defects warranty for a period of 5 years from date of installation. The compressor shall have a warranty of seven (7) years from date of installation. This warranty does not include labor.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide split system air conditioning unit of type, size and configuration indicated and with the following features and accessories.

B. System shall consist of an outdoor condensing unit with a matched capacity indoor fan coil unit.

2.2 OUTDOOR CONDENSING UNIT

A. Cabinet casing shall be constructed from galvanized steel plate, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. The fan grille shall be of ABS plastic. Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions for use in Hurricane condition areas.

B. Unit shall be furnished with a low ambient wind baffle and capable of cooling operation down to 0°F ambient temperature without additional low ambient controls.

C. The L-shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up and allow maximum airflow. The coil shall be protected with an integral metal guard. Unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent external contact with moving parts.

D. Compressor shall be inverter driven variable speed type with internal overload protection.

E. Unit shall be equipped with an electronic control board that interfaces with the indoor unit to perform all necessary operational functions.

F. Unit shall be completely factory assembled, piped, wired and test run at the factory.

2.3 INDOOR WALL MOUNTED FAN COIL UNIT

A. Unit shall be capable of being affixed to a vertical wall by means of a factory supplied, pre-drilled, mounting plate. The cabinet shall be formed from high strength molded plastic with smooth finish, flat front panel design with access for filter. Cabinet color shall be white.

B. The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.

2.4 SYSTEM CONTROL

A. Control system shall consist of a minimum of two (2) microprocessors, one in each indoor and outdoor unit, interconnected by a single non-polar two-wire cable.

B. Wired Remote Controller: 12/24 volts, DC, wired from indoor unit. Backlit LCD display with features including but not limited to: On/off Control, Temperature setpoint, fan speed selector, temperature sensor, time scheduling, and Cool/Auto/Fan/Dry mode selector.

2.5 MANUFACTURERS

A. Manufacturers: Daikin, LG, Mitsubishi and Samsung.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install indoor and outdoor units as indicated, and in accordance with manufacturer's installation instructions.

B. Install units level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

C. Connect refrigerant piping to units including installation of field mounted accessories.

D. Coordinate electrical connection requirements with Electrical Contractor. Power to the indoor unit shall be supplied by the outdoor unit.

E. Provide control wiring to accomplish the sequence of operation.

F. Testing: Charge systems with refrigerant and oil, and test for leaks. Repair leaks and replace lost refrigerant and oil.

G. Start-up units, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

END OF SECTION 23 81 26

SECTION 23 82 03 – ELECTRIC HEATING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDES

Electric Unit Heaters

1.2 SUBMITTALS

A. Refer to Section 23 01 00.

PART 2 - PRODUCTS

2.1 ELECTRIC UNIT HEATERS:

A. Provide electric unit heaters of type, size and configuration indicated and with the following features and accessories.

B. Heavy gauge steel casing with baked enamel finish. Provide hanger with drilled or threaded connections. Steel-sheathed heating element with built-in automatic reset high limit switch. Continuous duty motor directly connected to fan. Fan shall be statically and dynamically balanced. Discharge louver shall be fully adjustable. Controls shall be factory mounted and include fan delay relay, operating contactor, and unit mounted thermostat.

C. Provide two-step control for heaters 5 KW and over.

D. Heater shall be suitable for installation with wall/ceiling bracket or four corner support brackets, furnished with the heater.

E. Manufacturer: Q-Mark MUH or equivalent by Brasch, Raywall, Markel, Electromode or Indeeco.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install heaters as indicated, and in accordance with manufacturer's installation instructions.

B. Install each heater level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

C. Unit Heaters: Support from wall or ceiling utilizing factory furnished wall/ceiling bracket or corner support brackets.

D. Coordinate electrical connection requirements with Electrical Contractor.

END OF SECTION 23 82 03

SECTION 260100 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED CONTRACT DOCUMENTS

A. The provisions of the Instructions to Bidders, General Conditions, Supplementary Conditions, Alternates and Addenda are a part of this Specification. Contractors and Subcontractors shall examine these provisions as they may affect work under this Division.

B. Contractor shall examine Division 1 Contract Documents for general project requirements.

C. Contractor shall also examine the Contract Documents of all Divisions which may affect work under this Division. Contractor shall be responsible for electrical work required.

1.2 DESCRIPTION OF WORK

A. This project involves work in an existing operating facility and will require close communication with Owner in regards to access and work hours. Coordinate all work schedules prior to bidding with Owner and Construction Manager.

B. Electrical, Architectural, HVAC, Plumbing, Fire Protection, Structural, Civil, Technology and all other Drawings as well as the Specifications for all the Divisions shall be defined as the Contract Documents. Contractor shall review entire set of Contract Documents prior to bidding.

C. Drawings and Specifications are to be considered as supplementing each other. Work specified but not shown, or shown but not specified, shall be performed or furnished as though mentioned in both the Specifications and the Drawings.

D. Prior to submitting bid, Contractor shall examine all Drawings and Specifications to develop a complete understanding of the project scope. Contractor shall ask for clarifications during the pre-bid phase of the project. Failure to do so will not relieve the Contractor of their responsibility to perform all required work.

E. Where the project scope involves renovations and additions, it is required that Contractors visit the site of the work and become familiar with the conditions affecting the installation. Submission of a bid shall presuppose knowledge of such conditions and no additional compensation shall be allowed where extra labor or materials are required because of the lack of knowledge of these conditions.

F. Bid shall include any special phasing requirements related to the construction work as described in the Contract Documents. Coordinate with Division 1.

G. Extra costs which might result from deviations from the Drawings, so as to avoid interferences, shall be considered a "Job Condition", and no additional compensation shall be considered applicable. In the event that such interferences occur in course of the work, due to an error, omission, or oversight by the Contractor, no additional compensation shall be allowed. Interferences that may occur during the course of construction shall be brought to the immediate attention of the Architect and Engineer, and the Architect and Engineer's decision, confirmed in writing, shall be final.

H. The following general terms as used within the context of the Electrical Contract Documents shall be defined as follows:

1. "Contract Documents" - The complete set of Drawings and Specifications for all Divisions included in the project.
2. "Drawings" - Drawings furnished as part of the Contract Documents.
3. "Contractor" - Electrical Contractor and the Electrical Contractor's Subcontractors.
4. "Responsible" - To perform work required.
5. "Furnish" - To supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, and similar operations.
6. "Install" - Work which includes the actual unloading, unpacking, assembly, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
7. "Provide" - To furnish and install, complete and ready for the intended use.
8. "Equal" - To meet or exceed the standards of the specified products or listed manufacturers.
9. "Mechanical" - HVAC, Plumbing and Fire Protection Divisions as applicable.
10. The term "Technology" shall refer to all low voltage systems, related cabling infrastructure and conduit/backbox rough-in work indicated on the Division 27 Contract Documents. Refer to the Technology General Provisions section for additional Technology definitions.

1.3 WORK INCLUDES

A. The Electrical Contractor is responsible for all work scope included in the Division 26 Contract Documents and applicable Division 26 scope indicated in the Division 27 Contract Documents. A separate Technology Contractor is responsible for all work scope included in the Division 27 Contract Documents unless otherwise indicated in the Division 27 Contract Documents.

B. Include all labor, material, equipment, services, permits, coordination, supervision and administration necessary for the proper completion of all electrical work shown. Items omitted, but necessary to make the Electrical systems complete and workable shall be understood to form part of the work.

C. Material for work required to complete installation such as earthwork, concrete, masonry, mortar, reinforcing steel, patching and painting shall be provided as specified in other applicable Divisions covering such work.

D. Provide material and labor which is neither drawn nor specified but which is obviously a component part of and necessary to complete work and which is customarily a part of work of similar character.

E. Include all testing, test reports, system programming, start-up reports and warranties for each system as outlined elsewhere in these Specifications. Refer to "Operating and Maintenance Manuals" for additional requirements.

1.4 PERMITS AND FEES

A. Secure and pay for permits and inspections required for the electrical work. Turn over certificates of approval to the Owner or Construction Manager promptly when received, and before payment is made for the work.

B. Give proper authorities notice as required by law relative to the work in their charge. Comply with the regulations regarding temporary enclosures, obstructions or excavations and pay all legal fees involved.

1.5 QUALITY ASSURANCE

A. Work shall be installed in accordance with all applicable provisions of the National Electrical Code, as interpreted by the local Authority Having Jurisdiction (AHJ), as well as any further modifications or regulations published by local or State Authorities.

B. Reference to the code and standards listed shall constitute the minimum acceptable requirements. Nothing in the Specifications shall be construed to permit deviation from the requirements of the governing code. Where requirements of the Drawings and Specifications exceed those of the code listed, follow the Drawings and Specifications.

C. Provisions of the latest revisions to the following adopted codes and standards shall be followed where applicable:

1. Ohio Building Code, 2017 with amendments
2. Ohio Fire Code, 2017
3. Ohio Energy Code (IECC, 20012 or ASHRAE 90.1, 2010)
4.
5.

D. Applicable portions of the following codes, standards, societies and agencies shall be followed. Where a specific edition is listed, it shall be used. Where not listed, the edition recognized by the Authority Having Jurisdiction shall be used. Listing of a specific portion of a code, standard, society or agency does not preclude the Contractor from following all other applicable portions of the code, standard, society or agency.

1. National Fire Protection Association (NFPA):

   a. NFPA 70 - National Electrical Code, 2017
   b. NFPA 72 - National Fire Alarm Code, 2016
   c. NFPA 110 - Emergency and Standby Power Systems, 2016

2. American National Standards Institute (ANSI):

   a. ANSI 117.1 - Specifications for Making Buildings and Facilities Accessible To, and Usable By, the Physically Handicapped

3. Americans with Disabilities Act (ADA) - Americans with Disabilities Act Accessibility Guidelines (ADAAG), 2004.
4. Federal Occupational Safety and Health Act (OSHA)
5. National Electrical Manufacturers Association (NEMA)
6. Institute of Electrical and Electronic Engineers (IEEE)
7. American Society of Testing and Materials (ASTM)
8. Illuminating Engineering Society (IES)
9. Underwriters Laboratories, Inc., Standards for Safety (UL)

E. Workmanship shall be in accordance with the best NECA (National Electrical Contractor Association) practices of the trade. Electrical work shall be installed by journeymen electricians under the supervision of a competent foreman.

1.6 WORK REQUIRED FOR EQUIPMENT FURNISHED OR PROVIDED BY OTHERS

A. Low voltage (under 120 volts) temperature and interlock controls shall be provided and wired by the HVAC or Plumbing Contractor. The Electrical Contractor shall provide necessary 120 volt power, terminated at junction boxes, as directed by the HVAC or Plumbing Contractor.

B. 120 volt control devices, such as thermostats and aquastats, which control fractional horsepower, 120 volt motors shall be furnished by the HVAC or Plumbing Contractor and shall be installed and wired by the Electrical Contractor. The exact wiring requirements shall be as recommended by the Manufacturer of the equipment.

C. 120 volt control devices, such as thermostats and aquastats, which control motors rated 208 volts and higher shall be furnished, installed and wired by the HVAC or Plumbing Contractor. Refer to the Mechanical Controls Specification for additional requirements.

D. The Electrical Contractor shall wire items normally associated with equipment supplied by others such as line voltage limit switches and motor operated dampers. Line voltage shall be defined as the same voltage that the associated equipment is rated.

E. Starters supplied as an integral part of the equipment shall be provided under the Division furnishing the equipment. All other disconnect switches and starters shall be provided and wired by the Electrical Contractor.

F. Variable frequency drives furnished under the Division providing the equipment being controlled shall be installed and wired by the Electrical Contractor. Any associated additional disconnect switches shall be provided by the Electrical Contractor.

1.7 ELECTRONIC MEDIA

A. Electronic drawing files are available to the Contractor, from the Engineer for coordination purposes as defined in Division 0 and Division 1.

B. Contractor shall deliver closeout documents on a portable memory device. Portable memory device shall refer to CD, DVD, Flash Drive, external hard drive or any other portable media used for storing electronic files.

1.8 SUBMITTALS

A. Prior to commencing work, submit product data and/or shop drawings for Electrical equipment, materials and systems as described herein and as required in each individual Division 26 Specification section. Provide all submittals far enough in advance of scheduled dates for installation to provide sufficient time for reviews, for securing necessary approvals, for possible revisions and re-submittals, and for placing orders and securing delivery.

B. Prepare Submittals with adequate details and dimensions as necessary to clearly show construction. Clearly identify each item on the Submittal with designation as indicated on Drawings including location and use. Include with Submittals, Manufacturer's published descriptive literature, specifications, performance data (normal operating characteristics, ratings, etc.), wiring diagrams, and installation instructions. Indicate for each item the operating characteristics, design conditions, features, and optional items that are intended for application on this project. Where contents of Submittal literature includes data not pertinent to the Submittal, clearly indicate (highlight) which portion of content is being submitted for review.

C. If for any reason, the Submittal shows variations from the requirements of the Contract Documents, the Contractor shall make mention of such variation in the letter of transmittal. The Contractor shall note in red on the Submittal any change in design or dimension on the items submitted including changes made by the Manufacturer which may differ from catalog information.

D. Where additional installation drawings, wiring diagrams or other drawings are specified elsewhere as part of the project requirements, they shall be submitted at the same time as the Submittals and product data. Partial Submittals are not acceptable.

E. Contractor shall review each Submittal prior to submission and check for compliance with the Contract Documents. Corrections shall be noted. Mark with approval stamp prior to submission. Submittals that do not bear the Contractor's approval stamp will be returned without action.

F. The Submittals will be reviewed only for General compliance and not for dimensions, quantities, etc. The Submittals that are returned shall be used for procurement. The responsibility of correct procurement remains solely with the Contractor. The Submittal review shall not relieve the Contractor of responsibility for errors or omissions and deviations from the Contract Document requirements. Submittals which are not required under this Division shall be returned to the Contractor.

G. After review of submittals by the Engineer, the Contractor shall revise and resubmit if required to establish compliance with the Contract Document requirements. Resubmittal shall include a document with a written response to each of the Engineer's previous comments.

H. The Contractor shall notify the Engineer when all product data and/or shop drawings for electrical equipment, materials and systems have been submitted for review.

I. The Contractor agrees that Submittals, processed by the Engineer, are not change orders; that the purpose of submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design intent of the project. This understanding is demonstrated by indicating which equipment and material is required, and by what methods of fabrication and installation will be utilized.

J. The Contractor further agrees that if deviations, discrepancies or conflicts between the Submittals and the Contract Documents are discovered, either prior to or after Submittals are processed by the Engineer, the Drawings and Specifications shall control and shall be followed.

K. Final reviewed submittals shall be included in the Operating and Maintenance Manuals. Where Submittals are returned "REVIEWED, EXCEPTIONS AS NOTED", the final Submittals shall be updated to include the exceptions. Upon ordering equipment, order sufficient number of sets of product data literature for the Operating and Maintenance Manuals.

L. Submit product data for the following. Refer to specific Specification sections for additional requirements.

1. Grounding System Components and Fittings
2. Panelboards
3. Conductors
4. Splice Kits
5. Overcurrent Protection Devices
6. Disconnect Switches and Motor Starters
7. Surge Protective Devices (SPD's)
8. Handholes
9. Luminaires, Lamps, Ballasts and Drivers
10. Switches, Occupancy Sensors, Photocells, Timeclocks
11. Receptacles
12. Networked Lighting Management System
13. Any other specified system or equipment not listed

M. Submit shop drawings for the following. Where project floor plans are required, refer to electronic media section for requirements obtaining electronic drawing files. Refer to specific Specification sections for additional requirements.

1. Power Company Service Installation Drawings
2. Grounding System layout including connections to all building components
3. Site Lighting Point by Point Calculation

1.9 CONSTRUCTION DOCUMENTATION

A. Coordination Drawings:

1. Refer to Division 1 for additional requirements.
2. Preparation of the Coordination Drawings shall be the responsibility of the HVAC Contractor.
3. Coordination Drawings shall include but not be limited to: locations of equipment and devices, ductwork, piping, and conduit routing and required service clearances for all trades. Show the relationship of all components as related to installation and future access for maintenance and removal. Where access doors are required, indicate locations and type. Show locations of all ductwork, piping and conduit penetrations through wall and floors.
4. Supply HVAC Contractor information necessary for the development of coordination drawings. Information shall include but not be limited to: locations and sizes of Electrical equipment and devices; conduit routing and sizes; and required service clearances affecting the work of other trades. How this information is supplied shall be discussed and decided between all trades. Coordination meetings between all trades are required.
5. Before supplying information to the HVAC Contractor, coordinate locations of all floor, wall, and roof penetrations including sleeve requirements with General Trades. Coordinate locations and types of all access doors with the Architect and General Trades.
6. Contractor shall approve Coordination Drawings prior to Submittal to Architect for review and must indicate acceptance of illustrated conditions by attaching their endorsement to each Drawing.
7. Proceed with installation only after review of Coordination Drawings by Architect and approval from other trades affected. Architect does not approve Coordination Drawings.

8. The Coordination Drawings shall be updated to include any deviations made during construction as required to create Record Drawings.

B. Tests, Start Ups and Adjustments

1. During the construction period provide the following tests:

a. Voltage and confirmation that voltage is within acceptable tolerance.
b. Ground ohm readings and confirmation that readings are within acceptable tolerance.

1.10 GUARANTEE AND WARRANTIES

A. Warrant that equipment and all work is installed in accordance with good workmanship practice. All equipment shall be installed in accordance with the Manufacturer's recommendation and shall meet the requirement specified. Any equipment failing to perform or function as specified shall be replaced with complying equipment without cost to the Owner. Warranty shall commence upon acceptance of substantial completion of construction by the Owner. Sign-off of individual equipment start-up procedures shall not activate the warranty commencement.

B. The Contractor shall review the construction schedule requirements defined in Division 1. Where necessary to accommodate the schedule and where equipment and systems are installed that are used by the project until the date of substantial completion, the Contractor shall provide an extended warranty as part of the bid to cover the equipment warranty until the date of substantial completion.

C. Guarantee against defects in workmanship and materials; repair or replace any defective work, material or equipment within one year from date of formal written warranty commencement. Longer product warranties provided by individual equipment manufacturers shall supersede this one year guarantee; however, the Contractor shall maintain the one year workmanship and materials guarantee for installation of such equipment. Coordinate guarantee and warranty requirements with Division 1 Specifications.

1.11 CLOSEOUT DOCUMENTS

A. Record Drawings:

1. Record Drawings shall consist of marked-up Drawings as defined elsewhere in the Specifications. Refer to Division 1 for quantities, special formatting, and additional requirements.
2. The Contractor shall keep one complete set of the Drawings on the project site on which shall be recorded any deviations or changes from such Drawings made during construction. These Drawings shall become the Record Drawings, shall be kept clean and undamaged, and shall not be used for any other purpose other than recording deviations from Drawings. At the end of the project, the Contractor shall make electronic .pdfs of these drawings and transfer them onto a portable memory device. Both hard copy drawings and the portable memory device shall be provided as Record Drawings.

3. The Contactor shall maintain updated Coordination Drawings, reproduced electronically from the original Coordination Drawings in an approved format. Drawings shall include any deviations or changes made during construction. Drawings shall only include Division 26 work. Work of other divisions shall be removed. At the end of the project, the Contractor shall transfer the electronic drawing files onto a portable memory device. Both hard copy drawings and the portable memory device shall be provided as Record Drawings.
4. The Contractor shall maintain an updated electronic Construction Model in an approved format. Model shall include any deviations or changes made during construction. In addition, electronic .pdf prints of the Construction Model shall be created. At the end of the project, the Contractor shall transfer the electronic model and .pdf prints onto separate portable memory devices. These two portable memory devices and hard copy .pdf prints shall be provided as Record Drawings.
5. Record Drawings shall indicate the location of all underground, under floor and concealed conduits including the location of all utility service entries.
6. Record Drawings shall indicate rated walls where firestop materials have been applied.
7. After the project is completed, the Record Drawings shall be delivered to the Architect for inclusion into Operating and Maintenance Manuals, as a permanent record of the installation as constructed.

B. Operating and Maintenance Manual (OMM)

1. Furnish complete bound sets of Operating and Maintenance Manuals. Refer to Division 1 Specifications for quantities and for additional requirements.
2. Each OMM shall be assembled into one book.
3. Bind the required material into a hard-backed binder where they can be accommodated into 8-1/2" x 11" size. Material shall be assembled as follows, unless otherwise directed in Division 1 Specifications:

    a. First Page -- Title of Project, Owner, Address, Date of Submittal, Name of Contractor and Name of Engineer, including contact information, phone number and email addresses.
    b. Second Page -- Index
    c. First Section -- Written description of system contents including where actually located in building, how each part functions individually, and how system works as a whole. Conclude with a list of items requiring service and either state the service needed or refer to the Manufacturer's data in the binder that describes the proper service.
    d. Second Section -- A copy of each shop drawing and catalog data sheet with an index at the beginning of the section.
    e. Third Section -- A copy of each Manufacturer's operating and maintenance instructions with an index at the beginning of the section, and a copy of each Manufacturer's start up report.
    f. Fourth Section -- A copy of each wiring diagram utilized in the installation.
    g. Fifth Section -- A copy of all test results, in chart form, performed by the Contractor.
    h. Sixth Section -- Copies of all warranties, approvals, etc.
    i. Seventh Section -- Owner training sign-in sheets and a copy of all digitally recorded training sessions.
    j. Eighth Section -- Record Drawings.
    k. Ninth Section -- A list of attic stock furnished for the project.
    l. An index shall be included at the beginning of each individual section.

4. Once submittals are completed, provide an OMM index to the Engineer for review. Once index is approved, submit an electronic copy of the OMM to the Engineer for acceptance. If any sections are incomplete, include section title tab and a page describing what is missing. After acceptance, submit the required quantity of final hard copies to the Architect for delivery to the Owner. If data is missing from final copies, a page shall be inserted into the front of the OMM listing what is missing and a date when the data will be available for insertion into the OMM.
5. After acceptance, information contained within the OMM shall be transferred onto a portable memory device and delivered with the OMM. Data shall be in .pdf format and submitted as a bookmarked electronic document utilizing interactive index tabs. In addition, a portable memory device shall be delivered to the Engineer.

    a. OMM index page shall have cross-reference links to each section.
    b. Sections containing more than 30 pages shall have a section index with cross-reference links.

1.12 OWNER TRAINING

A. Before final payment, demonstrate to the Owner's satisfaction the proper operation of each of the systems provided as part of the Contract Documents.

B. Provide to Owner after all equipment, systems and controls are in operation and at an agreeable time, instructions for the purpose of training Owner's maintenance personnel in the operation and maintenance of all Electrical equipment, systems and controls.

C. Provide a "sign-in" sheet at each training session. A copy of each "sign-in" sheet shall be included in the Operating and Maintenance Manual.

D. The Contractor shall video record training sessions for systems if required in other Specification sections. Turn one copy of each on DVD over to the Owner upon completion as part of Operating and Maintenance Manual. Coordinate preferred type of recording media with the Owner.

E. Refer to individual Division 26 sections for minimum time periods for training.

F. Deliver to the Owner all special tools and appurtenances for proper operation and maintenance of the equipment provided and request receipt for same. Attach to the Contractor's request for final payment.

1.13 SITE REPORTS AND PUNCHLISTS

A. The Engineer may visit the site periodically during construction and provide written Construction Observation Reports to the Contractor identifying areas where installation does not meet the intent of the Contract Documents. The Contractor shall provide a written response to these reports within 5 business days, indicating the reason the installation is out of compliance with the Contract Documents. After review, the Engineer may or may not require the Contractor to correct the installation.

B. Final Punch List

1. The Engineer will visit the site to perform a scheduled Final Punch List to identify areas where the installation is incomplete or does not meet the intent of the Contract Documents.
2. If the Engineer is requested to perform the Final Punch List, prior to the Contractor being 100% complete with their scope of work, the Contractor shall furnish a Contractor's Completion List, indicating all incomplete work. This list shall be furnished to the Engineer a minimum of 24 hours prior to the scheduled Final Punch List.
3. The Contractor shall respond to each punch list item along with a date, indicating that the item has been completed or corrected.
4. A copy of the Final Punch List with the Contractor's responses shall be included in the Operation and Maintenance Manual.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. All equipment and materials used on this project shall be new and UL Listed for the intended application. Where possible, the same brand or Manufacturer shall be used for each type of material or equipment.

B. Equipment and materials for the construction shall be the responsibility of the Contractor and shall be protected by the Contractor until formally accepted by the Owner.

C. All Manufacturers of electrical equipment shall verify to the satisfaction of the Contractor and Engineer that their equipment will function properly under the conditions of use, as shown on the Drawings and as specified herein. dimensions, weights, operating characteristics and all other related appurtenances shall be verified before submittal of shop drawings.

2.2 Domestic steel shall be used for all steel products as required by the (Ohio Revised Code, Chapter 153). MATERIAL SUBSTITUTIONS

A. Bids shall be based upon the specified products, suppliers or listed alternatives. The Drawings and Specifications are based on the products specified by type, model, size and suppliers if indicated and thus establish minimum qualities which substitutes must meet to qualify for review.

B. Should the Contractor propose to furnish materials, equipment and/or suppliers other than those specified, submit a written request for substitutions to the Architect or Engineer in accordance with Division 1 requirements. The request shall be an alternate to the original bid and shall be accompanied with complete descriptive (manufacturer, brand name, catalog number, supplier name and references, etc.) and technical data for all items. Indicate any additions or deductions to the base bid price.

C. Where listed alternatives, substitutions or equipment manufacturers (other than the basis of design) alter the design or space requirements indicated on the Drawings, the Contractor shall be responsible for the revised design and construction including cost of all associated trades involved.

D. Acceptance or rejection of the proposed substitutions shall be subject to approval of the Architect or Engineer. If requested, the Contractor shall submit inspection samples of both the specified and the proposed substitute items for review.

E. In all cases where substitutions are permitted, the Contractor shall bear any and all extra cost of evaluating the equality of the material and equipment to be installed.

F. Where only one Manufacturer or supplier is named in the Contract Documents, the system or equipment shall be provided as specified.

G. Verbal requests or approvals of substitutions shall not be binding on the Architect, Engineer or Owner.

PART 3 - EXECUTION

3.1 SAFETY

A. The Contractor shall follow all safety requirements as defined herein, as described in Division 1, and as defined by Owner safety protocols.

B. Work shall be performed on de-energized equipment in accordance with NFPA 70E.

C. Should hazardous materials be encountered, Contractor shall adhere to procedures, methods and regulations of the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA) and immediately notify Owner.

3.2 COORDINATION

A. Consult the Contract Documents and Submittals pertaining to the work for other trades. Review the field layouts for all trades and make adjustments accordingly in laying out the Division 26 work.

B. Examine the work of all other trades when it comes in contact with, or is covered by, work in this Division. Do not attach to, cover up, or finish against any defective work, or install work in a manner which will prevent proper installation of the work of other trades. Contractor shall be responsible for the costs of adjustments required.

C. Take all field measurements necessary and assume responsibility for the accuracy.

D. Install work that is to be concealed within the building construction in sufficient time to secure proper location without delay to the Work of other trades.

E. Assume responsibility for location of chases, other openings through masonry and concrete construction. When work cannot be installed concurrent with building construction, arrange for rough-in boxes, sleeves, inserts and other items, as necessary for installation thereof at a later date.

F. If any work is installed such that the architectural design cannot be adhered to, Contractor is responsible for cost of making such changes as Architect may require. Before installing work, report any interference between work of this Division and work of other Divisions to Architect as soon as discovered. Architect will determine which work must be relocated, or make adjustments to maintain clearances, maximum headroom and to avoid conflict with other work.

G. Become familiar with the construction where work attaches. Review Structural Drawings for coordination of openings. Cut no structural members or slabs without Architect's written approval.

H. Exercise caution when working in areas where concealed systems or materials may exist. Any costs for repair of damage incurred shall be the responsibility of Contractor causing the damage.

3.3 PROTECTION

A. All finished surfaces shall be protected from damage and spills during construction.

1. Protect finished floors with a heavy duty flexible fiber reinforced floor protection board - Ram Board or equal.
2. When setting up pipe cutting and threading machines, protect area against staining and abrasion.
3. Protect finished surfaces from chips and cutting oil by use of a chip receiving pan and oil proof cover.
4. Protect finished surfaces from paint droppings, insulation adhesive, etc. by use of drop cloths.

B. Cost of correcting any such condition will be charged against the respective Contractor.

3.4 PRODUCT HANDLING

A. Pay all costs for transportation of materials, equipment to job site.

B. Provide all scaffolding, tackle, hoists, rigging necessary for placing electrical materials and equipment in their proper place. Scaffolding, hoisting equipment: comply with applicable Federal, State, and Local regulations. Remove temporary work when no longer required.

C. Arrange for packaging of equipment, which must be hoisted, so that there will be no damage or distortion caused by hoisting operation.

D. Store Electrical equipment, etc., in a dry location and protect all Electrical equipment from dirt and moisture until the building is ready to receive them.

E. Coordinate location of stored items with other trades. Where necessary, store materials and equipment on movable carts so they may be moved when interfering with the work of other trades.

3.5 CUTTING AND PATCHING

A. All cutting and patching in construction as necessary for installation of this work shall be the responsibility of this Division and performed by the Tradesmen related to that specific Division of Work. Subcontract this work to the appropriate Trade Division.

B. Do not cut any structural member, including but not limited to steel framing and structural floors, without specific permission from the Architect and Structural Engineer.

C. Do not cut openings in roof or floor construction without specific permission from the Architect and Structural Engineer.

D. Where locations of penetrations are inaccurate or where building components are improperly cut by inadequate methods, the Contractor in error shall be responsible for complete repair.

E. The Contractor shall assume responsibility for removing and replacing existing ceiling tiles as required for installation of all work. Areas include that as outlined by the project scope and areas outside the scope where the Contractor is required to make connections to existing systems and install new work. Damaged tiles shall be replaced.

3.6 DAMAGE AND EMERGENCY REPAIRS

A. Assume responsibility for any damage to new building components caused by work provided as part of Contract Documents. Repair all damage without extra cost to Owner.

B. Owner reserves the right to make emergency repairs as required to keep equipment in operation, without voiding Contractor's guarantee or relieving him of responsibility during warranty period.

C. Restore roads, grounds, paving building components, etc., to their original condition whenever this work causes damage.

3.7 CLEANING

A. At all times keep premises and building in neat and orderly condition, follow explicitly any instructions in regard to storing of materials, protective measures and disposing of debris.

B. After all tests and adjustments have been completed, clean all equipment leaving everything in working order at the completion of this work. Clean all equipment of dirt, dust, grease, oil, debris and paint, after all other trades have completed their work.

C. All debris created by the execution of this work shall be removed as directed by the Architect or Owner.

D. Upon completion of work remove all tools, equipment and surplus materials.

3.8 PAINTING

A. Finish painting is included under Division 9 - Finishes, except where specifically called for in Basic Materials and Methods.

B. Materials and equipment installed under this Division shall be left free from dirt, grease and foreign matter, ready for painting.

C. No equipment or conduits shall be field painted before being connected or terminated. Where in-field painting occurs, insure components required for continuation of grounding systems are protected from paint until connected and installed.

D. Damaged surfaces of prefinished materials and equipment shall be touch-up painted to match the existing finish.

E. Under no circumstance shall any open cabling be painted.

3.9 SERVICE SHUTDOWNS

A. This project involves remodeling of existing areas in an operating facility. Plan work including alterations and connections to existing facilities, to permit carrying on normal building functions. When necessary to temporarily interrupt a service, shutdowns shall be scheduled through the Owner and shall be done at a time as directed by the Owner. No additional compensation shall be allowed for these shutdown periods even though premium time work may be required unless specifically defined in Division 1.

B. Provide temporary service to equipment or systems that cannot be shut down, and as determined by Owner, or as described in the Contract Documents. Remove temporary services when permanent work is completed.

C. Provide a minimum of one week's notice to the Owner before any service shutdown is scheduled.

3.10 TEMPORARY JOBSITE SERVICE

A. Provide a temporary electrical service adequate in size for power tools, heating, for the use of all trades and for the lighting of each room during construction. Include all utility company charges for providing this service to the project site. This service shall be provided as described in the Division 1 Specifications.

1. Provide temporary lighting and power distribution equipment as directed by the General Contractor [and CM].
2. Provide a written description and/or typical layouts of temporary lighting for construction as required by the local Authority.
3. Provide temporary service to equipment or systems which cannot be shut down, as determined by the Owner.

B. Temporary wiring shall conform to OSHA requirements.

END OF SECTION

SECTION 260310 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Copper Wire and Cable

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment installed under this Contract shall be new and of the quality herein specified. Each class of materials shall be of the same type and make throughout the building.

2.2 COPPER WIRE AND CABLE

A. Wire and cable for branch circuits and for feeders, 600 volt and below shall be 90°C., 600 volt, Type THHN/THWN-2, copper only, unless otherwise indicated on the Drawings. Type XHHW shall also be acceptable for feeders. All 600 volt wiring shall be in conduit. Conduit shall be as specified elsewhere in these Specifications.

B. Where wire size is not indicated on the Drawings, use ampacity ratings of 60°C for wire 100 amperes and below, and 75°C for wire above 100 amperes, as listed in Table 310.15(B)(16) of the National Electrical Code.

C. Minimum size for power and lighting branch circuits, including lighting fixture "whips", shall be #12. Wire sizes #10 and smaller may be solid or stranded. Wire sizes #8 and larger shall be stranded.

D. Control wires shall be #14 stranded THWN copper. All control wiring shall be terminated with fork type "Sta-Kon" type connectors.

E. Secondary neutral conductors of K-rated transformers shall be sized at 200% of the ampacity of the phase conductors.

PART 3 - EXECUTION

3.1 WIRE AND CABLE

A. Wire shall be delivered to the project site in complete coils with Manufacturer's name and approval tag indicating wire size and type of insulation, fastened to each coil.

B. Wire shall be installed in all lighting and appliance panelboards, power panelboards, switchboards and switchgear in a neat and workmanlike manner per NEC and NECA standards. No coiled, excess and draped wiring is permissible.

C. Individual branch circuits are shown on the Drawings for clarity. Lighting and receptacle circuits may be grouped for homeruns, with a maximum of three (3) circuits per conduit.

D. Neutral conductors shall not be shared. Neutral conductors shall be provided in each outlet box containing luminaire control devices.

E. For 120 volt branch circuits where size is not shown, conductor size #12 minimum shall be used for circuits less than 125 feet, and size #10 minimum shall be used for circuits 125 feet or greater. Ground conductors shall also be increased to #10 accordingly.

F. Identify wire and cable for branch circuits as follows: For 208Y/120V, 3-phase, 4-wire systems, phase A/B/C shall be black/red/blue respectively with white neutral and green ground conductors.

G. Color coding of feeders shall be by means of colored tape or colored insulation at terminals.

1. If required, re-identify conductors at switches as required by Article 200.7(C) of the National Electrical Code.

H. Provide all branch circuits wiring with adhesive label indicating circuit number at the phase and neutral conductor at the termination location in each panelboard.

I. All mechanical wire and cable terminations shall be torque tightened with a torque wrench or a torque screwdriver to Manufacturer's recommended torque values.

J. It is the Contractor's responsibility to coordinate wire sizes shown on Drawings with lugs provided on mechanical equipment during the submittal phase. Any compression cable adapters required shall be provided and shall be listed for the intended current carrying capacity of the conductors specified.

K. Pull wire and cables into conduit using Ideal Industries "Yellow 77 or 77 plus", or equivalent product or method.

L. Leave 6 inches free wire at all outlet boxes for wiring device connection.

M. Mechanical means may be used to pull conductor size #4 and larger.

N. Joints in conductor size #10 and smaller shall be made with Minnesota Mining and Manufacturing Co. (3M) insulated "Scotch Locks", Ideal Industries "Wing-Nut", Thomas and Betts (T & B) Co. "Marrette" connectors, or with mechanically crimped sleeves as manufactured by Thomas and Betts (T & B) Co. or Ideal Industries. Connector sleeves shall be insulated with pressure sensitive electrical tape equal to Minnesota Mining and Manufacturing Co. (3M) Scotch No. 33 plus.

1. For joints located in exterior handholes or similar installations subject to occasional standing water, provide splice kits, Raychem GHFC-1-90 or equal.

O. Joints and splices in conductor size #8 and larger shall be made with pressure type mechanical connectors and insulated with electrical tape to 150% of the insulating value of the conductor insulation.

END OF SECTION

SECTION 260320 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Boxes

B. Conduits

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment installed under this Contract shall be new and of the quality herein specified. Each class of materials shall be of the same type and make throughout the building.

B. Raceway systems, conduit, boxes, grounding, busbars, hardware, cable tray, etc. required for all Technology systems, cabling and/or devices shall be provided by the Electrical Contractor unless otherwise indicated on the Drawings (Scope Matrix) or as indicated in the Division 27 Contract Documents. The Electrical Contractor shall fully coordinate all requirements with the systems suppliers and shall review the Technology Drawings and Specifications prior to bidding.

2.2 BOXES

A. Contractor shall provide junction boxes with covers in order to accommodate branch circuiting as shown on the Drawings.

B. Flush device boxes in masonry walls shall be masonry boxes listed for the purpose, or 4-inch square boxes with raised coverplates listed for masonry. Flush boxes in other walls shall have raised coverplates suitable for the wall material.

C. Wiring device boxes for surface conduit work shall be stamped steel boxes listed for their applications.

D. All junction boxes and pullboxes shall be 4 inch x 4 inch x 2 inch deep minimum, or sized in accordance with the National Electrical Code if a larger box is required. Junction box and pullbox coverplates shall be suitable for their intended use. Provide identification on the coverplates as described elsewhere in these Specifications.

E. All junction boxes for dimmers shall be 4 inch x 4 inch x 2-1/2 inch deep.

F. Exterior boxes shall be cast aluminum type. Where outdoor weatherproof receptacles are installed, weatherproof gasketing shall be provided.

2.3 CONDUITS

A. Electrical Metallic Tubing (EMT)

1. All conduits, unless otherwise specified herein, shall be Electrical Metallic Tubing (EMT). Conduits shall be ¾ inch trade size, minimum, unless otherwise noted on the Drawings or within these Specifications. Where sizes are not shown, conduits shall be as required to accommodate the number and type of conductors in accordance with the National Electrical Code wiring tables, but shall not be smaller than ¾ inch.

B. PVC Conduit

1. Interior underground conduit shall be Schedule 40 or 80 PVC. Such interior underground conduit shall be protected from damage during construction. All PVC conduit shall conform with NEMA Standard TC2 and UL 651.
2. Where building interior wall construction is comprised of masonry or poured concrete, PVC-40 shall be acceptable. Raceway shall transition to EMT prior to installation within the ceiling space in either plenum or non plenum conditions.

C. Fittings and Couplings

1. Cold-rolled steel double set screw fittings shall be used for all EMT conduits. Provide single set screw for ¾" conduits and smaller. Compression type fittings shall be used for all EMT conduits.

PART 3 - EXECUTION

3.1 CONDUITS

A. Interior Conduits

1. Conduits shall be continuous and secured to all boxes in such a manner that each conduit system shall be electrically continuous from the point of service to all device boxes. Conduits shall be supported in accordance with the National Electrical Code. Terminals of all conduits shall be furnished with locknuts and insulating bushings. Plug ends of each conduit with an approved cap to prevent the entrance of foreign materials during construction.
2. Flexible metal conduit and flexible metallic cable assemblies shall be supported at intervals not exceeding 4½ feet and within 12 inches of every outlet box, junction box, cabinet, light fixture, or fitting, unless otherwise allowed by the National Electrical Code.
3. Conduits concealed in masonry construction shall be installed during wall construction.
4. Install exposed conduits parallel to, or at right angles to building structural members. Vertical runs shall be plumb.
5. All conduits terminating in sheet metal enclosures shall be provided with a single grounding/bonding type locknut with a set screw.
6. All exposed conduit ends within enclosures shall be provided with insulated bushings.
7. Provide expansion conduit fittings at all points where conduits cross building expansion joints.
8. Empty conduits shall have #12 pullwires installed, with labels identifying the conduit's origin and destination.

9. Contractor shall provide a minimum of three empty ¾-inch conduits stubbed into the nearest accessible ceiling space (above or below) for all recessed panelboards, fire alarm control panels, and other system control panels.
10. Conduits, boxes or other raceway systems that penetrate through fire rated floors, walls, ceilings, decks, smoke partitions, etc. shall be constructed so as to maintain the integrity of the fire or smoke rated areas. Penetrations shall not exceed an aggregate area of 1 square foot in any 100 square feet of surface area, or as dictated by local codes.
11. A separation of 12 inches minimum is required between conduits and hot water piping, steam piping, and similar system piping.
12. PVC conduit shall not be used when crossing over steam piping. Rigid galvanized steel conduit shall be used for a minimum of 10 feet on either side of steam piping.
13. All interior building conduits shall be concealed in new construction, unless noted otherwise on the Drawings.

B. Exterior Conduits and Special Conditions

1. Conduits in wet or damp areas shall be water tight. Joints shall be sealed with weatherproof sealing compound. Contractor shall provide covers during Construction to prevent water from entering conduits.

C. Fittings and Couplings

1. Contractor shall utilize boxes, fittings and mounting accessories appropriate for the specific conduit systems installed as recommended by the conduit Manufacturer.
2. All PVC fittings and joints shall be cleaned and provided with associated adhesive.

3.2 OUTLET BOXES

A. Outlet boxes concealed in masonry construction shall be installed during wall construction.

B. All boxes shall be rigidly supported from the building structure independent of the conduit system. Boxes cast into masonry or concrete are considered to be rigidly supported. Box stabilizers shall be utilized to properly support boxes in metal stud construction.

C. All outlets, toggle switches and receptacles shall be centered with regard to paneling, trim equipment, etc., and shall line up with either bottom or top of masonry courses. Changes to the specified mounting heights of any device shall be approved by the Architect or Owner's representative before rough-in.

1. Changes will not be permitted where such changes conflict with ADA mounting height requirements.
2. Determine the actual direction of all door swings such that toggle switches and other control devices shall be installed at the lock side of doors unless otherwise noted or unless field conditions do not allow. Improperly located devices shall be relocated without additional expense to the Owner.

END OF SECTION

SECTION 260330 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Conduits

B. Handholes

C. Excavation, Concrete and Backfill

D. Underground Ductbanks

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment installed under this Contract shall be new and of the quality herein specified. Each class of materials shall be of the same type and make throughout the building.

2.2 CONDUITS

A. Exterior Underground Conduit

1. The Contractor shall verify all service conduit sizes, routing, quantities, and stub-up locations shown on the Drawings with the Utility Company. All service conduit requirements shall be provided as directed by the Utility Company. Such coordination with the Utility Company shall occur prior to commencing conduit installation.
2. Conduits passing from exterior to interior require foam based adhesive to protect water leakage into building to be installed after conductors are installed. Acceptable Manufacturer shall be Polywater FST-250 or approved equal.
3. Conduits that stub through the foundation walls into below grade areas shall be supplied with pipe seals as manufactured by Link-Seal, Wal-Rich, Mason-Dallas or an equivalent product or method as approved by the Engineer. Pipe seals shall be EPDM (black) with stainless steel hardware. The Contractor shall coordinate and verify exact requirements with the Architect prior to procurement and installation of the pipe seals.
4. Exterior underground conduit shall be schedule 40 PVC. Such conduit shall be encased in concrete under drives or roadways and any other locations indicated on Drawings, with a 3-inch envelope, minimum with a 2-inch separation minimum between duct bank conduits.

2.3 HANDHOLES

A. Provide handholes for exterior conduit runs as shown or noted on the Drawings.

B. Handholes shall be constructed of polymer concrete specifically made for exterior underground utility construction. The use of chopped fiberglass, high density polyethylene or high density polystyrene material is prohibited. Handholes shall be designed for 5,000 lbs. load over 10 square inches. Stackable and extendable assemblies shall be permitted where required to reach the depth of the conduits or to match finished grade.

C. Provide divided enclosures where indicated on the Drawings. Divided enclosures shall have dual logo covers.

D. Handhole covers shall be gasketed (flanged cover) and provided with tamperproof (penta-head) stainless steel hardware. Owner shall be furnished with two sets of pent-head sockets and cover hooks.

E. Handholes shall be concrete gray in color with cover logo as appropriate for system as follows:

1. "Electric" - Electric power feeders.
2. "Telephone" - Telephone service entrance conduit.
3. "Communications" - Communications cabling or rough-in.
4. "Irrigation" - Irrigation control circuits.

F. Handholes shall be as Manufactured by Quasite/Strongwell or approved equal.

PART 3 - EXECUTION

3.1 CONDUITS

A. Exterior Conduits and Special Conditions

1. Exterior underground conduits shall be installed 36 inches below grade, minimum.
2. Exterior underground conduits shall be water tight. Joints shall be sealed with weatherproof sealing compound. Contractor shall provide covers during Construction to prevent water from entering conduits.
3. Conduits passing from the exterior to the interior of a building shall be filled with an approved material to prevent the circulation of warm air to a colder section of the raceway per Article 300.7(A) of the National Electrical Code. Provide pullbox or similar device at this location such that material is visible for inspection.
4. Conduit supporting systems shall be attached to the deck, slab, or structural framing only and not to any other appurtenances at the ceiling such as mechanical ducts, pipes and suspended ceiling hanger wires, framing members, etc.
5. A separate ground conductor shall be installed in all feeder and branch circuit exterior underground PVC conduit.
6. PVC conduit joints shall be solvent welded watertight in accordance with the Manufacturer's recommendations.
7. For exterior underground PVC conduit, vertical transitions to an above ground exposed exterior condition shall be made with rigid steel ells. The underground transition from PVC to rigid steel shall be made five feet from the ell. When such conduit transitions within a building, it shall transition immediately upon penetrating up through floor such that entrance and connection to all distribution equipment shall be made with steel conduit and fittings.
8. For conduit encased within a concrete ductbank, minimum cover shall be 3 inches.

B. Fittings and Couplings

1. Contractor shall utilize boxes, fittings and mounting accessories appropriate for the specific conduit systems installed as recommended by the conduit Manufacturer.
2. All PVC fittings and joints shall be cleaned and provided with associated adhesive.

3.2 HANDHOLES

A. Install handholes as recommended by the Manufacturer.

B. Install handholes on a base comprised of 12 inches of gravel or crushed rock (tamped in 6 inch lifts) extending 12 inches beyond the outside edges of the enclosure.

C. Handholes shall not be installed in sidewalks or roadways unless indicated otherwise on the Drawings.

3.3 EXCAVATION, CONCRETE AND BACKFILL

A. Provide all excavation, concrete and backfill work necessary for installation of Electrical work exclusively. Refer to Division 1 Earthwork Specifications for additional requirements.

B. Prior to opening and excavation, effort shall be made to determine whether underground installations; i.e., sewer, telephone, water, fuel, electric lines, etc., will be encountered, and if so, where such underground installations are located. When the excavation approaches the estimated location of such an installation, the exact location shall be determined and when it is uncovered, proper supports shall be provided for the existing installation. Utility companies shall be contacted and advised of proposed work 48 hours PRIOR TO THE START OF ACTUAL EXCAVATION. Contact Ohio Utilities Protection Service at 1-800-362-2764.

C. Dig trenches to the exact grade and depth with only sufficient dirt removed at holes to provide working space. Refill trenches excavated below required depth to proper depth with sand. Shore or sheet pile trenches to prevent caving. Do not endanger work of other Contractors or existing structures. Contractor shall be held solely responsible for such damage.

D. In event that rock is encountered during excavation, notify the Architect at once.

E. After installation has been completed and approved for backfill, refill all excavation inside of the building and under paved areas outside of the building with #57 backfill per ASTM-448, the previously excavated material if this excavated material is determined by the Architect to be suitable for reuse, or premium backfill as determined by the Architect. Backfill shall be made and tamped in 6" layers. Refill trenches outside of the building and not under paved areas with selected dirt to 6 inches above finished grade to provide for settlement.

F. Sand exclusively is not permitted for backfill.

G. Remove and dispose of all material not used for backfill.

H. Special care shall be taken to protect trees and shrubbery adjacent to trenches. If roots of live trees are encountered during excavation, protect as directed by the Architect.

I. Provide and operate pumping equipment as necessary to keep trenches free of water.

J. When excavation is necessary in an existing lawn, reseed to match existing lawn, as directed by the Architect.

K. Where trenches cross roads, walks or parking lots, provide suitable barricades and bridges adequately protected by signs or red flags during day and by lights at night, as directed by the Architect.

L. Repave all roads, sidewalks or parking lots to the satisfaction of the Architect and the authorities having jurisdiction. Paving material or concrete shall match the existing conditions to the extent possible.

3.4 UNDERGROUND DUCTBANKS

A. Provide underground ductbanks as shown on the Contract Drawings. Provide detectable underground warning tape for future location with a common metal detector. Standard colors and warnings for different types of underground services shall be utilized.

B. Whenever possible, duct arrangements shall be restricted to either a two conduit width or a two conduit depth to allow side exposure of all ducts. When not possible, additional interior ducts with no side exposure shall be provided and shall remain empty.

C. The use of sand exclusively as backfill material is not permitted, in particular around Electrical conduits.

D. A separation of 12 inches minimum is required between power and communication system conduits installed in common trenches.

END OF SECTION

SECTION 262100 - POWER DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Power Distribution Equipment

B. Lighting and Appliance Branch Circuit Panelboards

C. Safety Switches

D. CT Metering Cabinets

E. Equipment Room and Feeder Layouts

PART 2 - PRODUCTS

2.1 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS (208Y/120 OR 240 VOLT RATED)

A. Furnish and install branch circuit panelboards equipped with circuit breakers, with frame and trip ratings listed on the Drawings.

B. Panelboard bus structure and main lugs or main circuit breaker shall have current ratings as shown on the Drawings. Such ratings shall be established by heat rise tests, conducted in accordance with UL Standard 67. Bus structure shall be insulated. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or phase sequence type and shall accept bolt-on circuit breakers. All current carrying parts of the bus structure shall be tin-plated aluminum. Each panelboard shall be fully bussed, ready to accept future devices. Each panelboard shall contain a grounding bus. Each panelboard shall contain a 100% rated neutral bus.

C. The panelboard bus assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel shall be as specified in UL Standard 50 for cabinets. Wiring gutter space shall be in accordance with UL Standard 67 for panelboards. The box shall be fabricated from galvanized steel or equivalent rust resistant steel. A circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door.

1. Fronts shall have "door-within-door" trim, hinged box to front type with latch on outer door. Fronts shall have an inner door over the branch circuit disconnect area secured with one latch with lock. Doors shall be mounted with completely concealed steel hinges. Fronts shall not be removable with door in the locked position.

D. Locks shall be flush cylinder tumbler type with catch and spring loaded door pull. All panelboard locks shall be keyed alike.

E. Each panelboard, as a complete unit, shall have a minimum symmetrical short circuit current rating no less than that required by the overcurrent protective devices specified elsewhere. This rating shall be established by testing with the overcurrent devices mounted in the panelboard in accordance with Underwriters Laboratories Standard UL 67. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage.

F. Panelboards shall be listed by Underwriters Laboratories and bear the UL label. When required, panelboards shall be suitable for use as service equipment. Panelboards shall be as manufactured by Square D, Siemens/ITE, General Electric or Eaton Cutler Hammer.

2.2 SAFETY SWITCHES

A. Safety switches shall be heavy duty fusible or nonfusible type as indicated on the Drawings, and shall be suitable for the voltage and current ratings as shown on the Drawings. Safety switches shall be UL Listed for their application.

B. Switches shall have switch blades which are visible in the "Off" position when the door is open. Switches shall have removable arc suppressors, where necessary, to permit easy access to the line side lugs. All current carrying parts shall be plated.

C. Switches shall have an integral quick-make, quick-break operating handle mechanism. Switches shall have a dual cover interlock to prevent opening of the switch door in the "ON" position or to prevent closing of the switch mechanism with the door open. Handle position shall indicate if the switch is "ON" or "OFF".

D. Fuse holders shall accept only Class J, R or L fuses.

E. Indoor enclosures shall be NEMA 1. Exterior enclosures shall be NEMA 3R. NEMA 1 enclosures shall be code gauge UL 98 sheet steel, treated with a rust inhibiting phosphate primer and finished in gray baked enamel. Enclosures shall be provided with padlocking provisions.

F. Acceptable manufacturers shall be: Square D, General Electric, Eaton Cutler Hammer or Siemens/ITE.

2.3 CT METERING CABINETS

A. Furnish and install CT Metering Cabinets as approved by the Power Company.

B. Cabinets shall be UL 414 listed as CT Metering Cabinets.

PART 3 - EXECUTION

A. LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS Panels shall be mounted so that the top of the cabinet is at 6'-0" above floor.

B. A glazed directory frame shall be provided inside each panel door and shall be of sufficient size to give a complete description of each circuit. Typed directory cards shall be provided with a detailed listing of each circuit served, including descriptions of the load and location (room numbers as applicable). Panelboard schedules included with the Contract Documents are not intended nor are they permitted to be used to meet this requirement.

C. Panels indicated with double lugging or oversized conductors on the Drawings shall be installed with an oversized tub or a wireway or splice box (flush mounted if required).

D. The Contractor shall balance the continuous load on each panel when the work is complete.

E. The branch circuit numbers used on the Drawings shall be applied for the construction. However, at the completion of the work, circuit number adjustments shall be made as required to provide balanced phase loading on each panel. Balancing required shall be no greater than 15%. Any rebalancing performed shall also require relabeling of the conductors.

F. Flush mounted panels shall be installed with a minimum of three empty 3/4" conduits stubbed up to the nearest accessible ceiling space for convenient future expansion.

G. Spare circuit breakers shall be identified as such on the panel directory cards and shall be left in the "OFF" position.

H. Provide engraved nameplates with information as shown on the Drawings.

I. Where wireways are installed to serve multiple branch panelboards, the conduits entering the panelboard shall be of size and quantity to allow the panel to be filled to maximum capacity based on total available breaker space and be no more than 50% filled.

END OF SECTION

SECTION 265100 – LED LUMINAIRES

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Interior Luminaires

B. Exterior Luminaires

1.2 DESCRIPTION OF WORK

A. Luminaires shall be provided as specified in the Luminaire Schedule or as indicated on the Drawings complete with lamps, power wiring, and control for a fully operational system. Contractor is responsible for providing proper mounting accessories. Contractor shall refer to this Specification for LED and driver requirements. Refer to the Drawings and Specifications for control requirements. Submittals shall include product information for luminaires. Where a catalog number and a narrative or pictorial description are provided, the written description shall take precedence. If equal or alternate luminaire Manufacturers are not indicated, then the luminaires shall be provided as specified. The Engineer is not responsible for the performance of substituted luminaires approved by the Architect or Owner without the consent of, or review by, the Engineer.

1.3 QUALITY ASSURANCE

A. Codes and Standards

1. Luminaires shall be installed in accordance with Article 410 of the National Electrical Code and shall be grounded as required by the National Electrical Code. The Contractor is responsible for proper installation of luminaires, including verification that luminaires are installed according to their intended use. Any conflicts regarding actual architectural conditions shall be brought to the attention of the Architect and Engineer immediately.
2. All luminaires and assembled components shall be new, of good quality, and bear the label of and be approved by UL laboratories for the applicable location and conditions (wet, damp, dry, etc.).
3. All luminaires shall meet all required local, state and/or national building, electrical and energy codes and regulations.

1.4 EXTERIOR PHOTOMETRIC POINT-BY-POINT CALCULATIONS

A. Manufacturer of exterior luminaires shall provide a comprehensive point-by-point calculation of the site. Calculations shall include all luminaires specified on the Contract Documents to provide illumination to horizontal surfaces.

1. Calculation points shall be on a 5 foot by 5 foot spacing minimum at ground level.
2. Pole height and pole base height shall be included in the photometrics, and indicated on the summary.
3. A light-loss factor of 0.9 shall be incorporated for LED lamping.

PART 2 - PRODUCTS

2.1 LIGHT EMITTING DIODES (LEDS):

A. Refer to the Luminaire Schedule for additional requirements.

B. General Requirements:

1. All products shall be tested by a Nationally Recognized Testing Laboratory (NRTL) in accordance with IES LM-79 testing methods and shall carry a UL or ETL label. Luminaire Manufacturer shall confirm in writing that the LEDs within the luminaire will not exceed the maximum temperature to which the LED die was tested using IES LM-80 testing methods.
2. All LEDs must be batch sorted for color and brightness visual consistency, and must be manufactured by a reputable LED Manufacturer, such as Philips Lumileds, Osram Sylvania, Nichia, Cree or approved equal. All luminaires of the same type shall be supplied at the same time and shall come from the same batch. Spare luminaires shall be provided from the same batch.
3. Color Rendering Index (CRI): Minimum CRI of 75.
4. All interior LEDs shall be 4000 K.
5. All exterior LEDs shall be 4000 K.
6. All LED components shall be mercury and lead-free.
7. All LED luminaires shall be subjected to the following JEDEC Reliability Tests for Lead-free Semiconductors: HTOL, RTOL, LTOL, PTMCL, TMSK, Mechanical Shock, Variable Vibration Frequency, SHR, Autoclave.

C. Thermal Management:

1. Luminaire Manufacturers shall adhere to device Manufacturer guidelines, certification programs, and test procedures for thermal management.
2. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the Luminaire over the expected useful life. The LED Manufacturer's maximum thermal pad temperature for the expected life shall not be exceeded.
3. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
4. The Luminaire shall have a minimum heat sink surface such that LED Manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature. The heat sink material shall be aluminum.

D. Special Warranty: Provide a written warranty indicating that the complete system (LED luminaires, drivers and power supplies) shall carry a minimum 5-year warranty.

2.2 led Drivers

A. Non-dimming LED drivers shall meet the following requirements:

1. Minimum Efficiency: 85%
2. Starting Temperature: -40° C
3. Input Voltage: 120 to 480 volts ±10%, single phase
4. Power Factor (PF): ≥ 0.90

5. Total Harmonic Distortion (THD): ≤ 20%
6. Sound Rating: Class A
7. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low – 6kV/1.2 x 50µs, 10kA/8 x 20µs) waveforms at 1 minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
8. Power supplies can be UL Class I or II output.

B. Dimming drivers shall be similar to non-dimming drivers, with the following additional requirements.

1. 0-10V dimming drivers shall dim to a minimum for 10%, and shall be type as recommended by manufacturer unless noted otherwise on the contract documents.
2. Drivers shall be compatible with dimmer control specified in the Luminaire Controls Specification Section.

C. Drivers shall comply with FCC 47 cfr Part 18 non-consumer RFI/EMI standards.

D. Provide low temperature drivers for LED luminaires in exterior applications or in unheated areas.

2.3 EXTERIOR POLE LUMINAIRES

A. Optical assemblies shall be provided with discreet over optical elements to provide IES Type II, III, IV or V distributions. Additional distributions for spill light control shall be utilized when light trespass must be mitigated where indicated on the Drawings. Mitigation must take place without external shielding elements.

B. Optical assemblies shall have a minimum efficiency of 85% regardless of distribution type. For Type II and Type III distributions street side efficiencies shall be a minimum of 80%. All LEDs and optical assemblies shall be mounted parallel to the ground. All LEDs shall provide the same optical pattern such that catastrophic failures of individual LEDs will not constitute a loss in the distribution pattern.

C. The illuminance shall not decrease by more than 30% over the expected operating life. The measurements shall be calibrated to standard photopic calibrations.

D. Backlight-Uplight-Glare: The luminaire shall not allow more than 10 percent of the rated lumens to project above 80 degrees from vertical. The luminaire shall not allow more than 2.5 percent of the rated lumens to project above 90 degrees from vertical. Backlight and Glare ratings as per luminaire schedule and calculated per IES TM-15.

PART 3 - EXECUTION

3.1 LUMINAIRE SUPPORTS

A. All boxes upon with luminaires are to be installed shall be equipped with 3/8 inch luminaire studs. Luminaires which weigh over 50 lbs. shall be supported independently of the box, unless the box is listed for the weight to be supported.

B. Boxes serving recessed luminaires in accessible ceilings shall be capable of being accessed through the ceiling opening. Install a maximum 6 feet of 1/2 inch flexible metal conduit (or MC cable) between the rigidly supported box and the luminaire housing. The box shall be located a minimum of one foot from the luminaire housing.

C. Surface mounted luminaires mounted on ceilings other than accessible lay-in ceiling systems, or to the building structure, shall be securely supported in a manner approved by the Architect. Mounting shall also be in accordance with Article 410 of the National Electrical Code, and as recommended by the luminaire Manufacturer.

D. Recessed luminaires shall be provided with mounting accessories compatible with the ceiling types installed. Plaster frames shall be furnished for each recessed luminaire installed in plaster or dry wall type ceilings. Verify all ceiling types with the Division 1 Contractor and with the Architectural reflected ceiling plans prior to submitting shop Drawings.

E. Recessed luminaires in accessible lay-in ceiling systems shall be supported as follows:

1. The grid system tees shall be supported at each corner of each luminaire with a suspended ceiling support wire up to a building structural member, or up to the structural deck. It is the responsibility of the Electrical Contractor to include such supports in Bid regardless of which Division installs the supports.
2. Each luminaire shall also be securely fastened to the grid system tees by mechanical means, such as bolts, screws, rivets or by clips identified for use with the type ceiling framing member installed.

3.2 MISCELLANEOUS

A. At the conclusion of the Work, each luminaire shall be in good operating condition.

3.3 EXTERIOR LUMINAIRES

A. Bases for exterior pole or post luminaires shall be formed as indicated on the Drawings with reinforced concrete. Crown top of base and weather seal exposed concrete. Paint bases as directed by Architect.

B. Provide low temperature drivers for all exterior luminaires and for luminaires in unheated rooms or areas.

END OF SECTION

SECTION 31 10 00 – SITE CLEARING

PART 1 – GENERAL

1.1 WORK INCLUDED

A. This section includes the following.

1. Protection of existing trees and vegetation to remain.

2. Removal of existing trees and other vegetation.

3. Clearing and grubbing. Include complete removal of any remaining stumps & vegetation.

4. Topsoil stripping.

5. Removal of above-grade site improvements and removal of any below grade improvements (ex. utilities, building foundations, etc. as applicable in order to install improvements shown on Contract Drawings).

6. Disconnecting, capping or sealing, and abandoning site utilities in place. Notify ENGINEER immediately if unknown utilities are encountered.

1.2 DEFINITIONS

A. "Topsoil": natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shades of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, and other objects more than 2 inches in diameter; and free of weeds, roots, and other deleterious materials.

1.3 MATERIALS OWNERSHIP

A. Except for materials indicated to be stockpiled or to remain on OWNER's property, cleared materials shall become CONTRACTOR's property and shall be removed from the site.

B. The ENGINEER/OWNER will direct the CONTRACTOR whether and/or where to store excess stripped topsoil on the property.

1.4 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

B. Record drawings according to Division 1 section "closeout procedures."

1. Identify and accurately locate capped utilities and other subsurface structural, electrical, technological, and mechanical conditions as applicable.

1.5 QUALITY ASSURANCE

A. Pre-installation conference: conduct conference at project site

1.6 PROJECT CONDITIONS

A. "Traffic": minimize interference with adjoining roads, streets, parking lots, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from OWNER and authorities having jurisdiction (AHJ).

2. Provide alternate routes around closed or obstructed traffic ways if required by OWNER, ENGINEER, or AHJ.

B. "Improvements on adjoining property": authority for performing indicated removal and alteration work on property adjoining OWNER's property will be obtained by OWNER before award of contract.

C. "Salvageable improvements": carefully remove items indicated to be salvaged and store on OWNER's premises where indicated, or alternate location where applicable (base bid).

D. Notify utility locator service before site clearing in accordance with Ohio revised code 153.64 "Protecting underground utility facilities during construction of public improvement".

E. The Ohio utilities protection service (OUPS) does not locate utilities outside public R/W's. The CONTRACTOR shall employ a qualified utility locating service for all underground utilities outside the public R/W.

PART 2 – PRODUCTS

2.1 NA

PART 3 – EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction. Replace if damaged to satisfaction of the OWNER/ENGINEER.

B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties, walkways.

C. Locate and clearly flag trees and vegetation to remain or to be relocated. Refer to SWPPP plans for additional information.

D. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to OWNER.

3.2 TREE PROTECTION & REMOVAL

A. Remove all trees indicated on the Contract Documents to be removed, and their major roots existing within the area of new pavements and structures.

B. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.

1. Do not store construction materials, debris, excavated material, or material stockpiling within drip line of remaining trees.

2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.

C. Do not excavate within drip line of trees, unless otherwise indicated.

D. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

1. Cover exposed roots with burlap and water regularly to prevent roots from dying out. Backfill with soil promptly.

2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3. Coat cut faces of roots more than 1-1/2 inches in diameter with emulsified asphalt or other approved coating formulated for use on damaged plant tissues.

4. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction in a manner approved by the Landscape Architect.

5. Use only hand methods for grubbing within drip line of remaining trees.

E. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by the ENGINEER.

1. Employ a qualified Arborist, licensed in jurisdiction where project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.

2. Replace trees that cannot be repaired and restored to full-growth status, as determined by the qualified Arborist.

F. Protection of trees and shrubs scheduled to remain shall be assigned to the general CONTRACTOR and shall include tops, trunks and roots. Temporary tree protection fences are required because of proximity to the work. Tree protective fencing should be 6' high chain link (2" mesh) or safety orange mesh fencing. Any pruning required shall be with the approval and direction of the Landscape Architect. The general CONTRACTOR shall be responsible for the survival of protected trees for two (2) years after the construction project is substantially completed.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

2. Arrange to shut off affected utilities with utility companies.

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

1. Notify ENGINEER/OWNER in writing not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without OWNER's and Architect's/ENGINEER's written permission.

3. The CONTRACTOR is to indicate in construction schedule any known utility interruption.

C. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING, GRUBBING AND TOPSOIL REMOVAL

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions, and grubbing roots. Strip all objectionable growth. Remove from the site all debris resulting from the stripping operations at frequent intervals to prevent accumulation of material. On-site disposal of material is not permitted.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or relocated.

2. Completely remove stumps, roots, obstructions, and debris extending to a depth of 24 inches below exposed & final subgrade. Do not dispose of on-site.

B. In a time defined prior to the start of construction, fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding 8-inch loose depth, and compact each layer in accordance with requirements for engineered fill.

3.5 TOPSOIL STRIPPING

A. Strip topsoil to its full depth from entire area to be graded. Stockpile where directed by OWNER and where it will not interfere with construction activities. Topsoil to be reused shall be free from roots, brush and debris. Excess topsoil shall be deposited and/or spread on property as directed by the Landscape Architect/ENGINEER/OWNER. Refer to Geotechnical report, and Landscape drawings, and specifications for additional information.

B. If stockpiling on-site, remove sod and grass before stripping topsoil.

C. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials.

D. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water away. Cover stockpiles to prevent windblown dust.

1. Limit height of topsoil stockpiles to 72 inches.

2. Do not stockpile topsoil within drip line of remaining trees.

3. Dispose of excess topsoil as specified for waste material disposal.

4. Install and maintain silt fence around any topsoil stockpiles.

3.6 SITE IMPROVEMENTS

A. Remove existing above-and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, foundations, utilities, and aggregate base as applicable.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.7 DISPOSAL

A. "Disposal": remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off-site.

1. Do not burn or bury removed materials on project site.

2. If hazardous materials are encountered during clearing operations, notify the ENGINEER for additional instructions. Comply with laws and ordinances concerning removal, handling and protection against exposure or environmental pollution.

END OF SECTION 31 10 00

SECTION 31 20 00 – EARTH MOVING

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Preparing sub grades for slabs-on-grade, walks, pavements, lawns, and plantings.

B. Excavating and backfilling for buildings and structures.

C. Drainage course for slabs-on-grade.

D. Sub-base course for concrete walks and pavements.

E. Base course for asphalt paving.

F. Subsurface drainage backfill for walls and trenches.

G. Excavating and backfilling trenches within building lines.

H. Excavating and backfilling trenches for buried mechanical, technology, and electrical utilities and pits for buried utility structures as applicable.

1.2 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 an excavated area to final grade.

B. Base Course: layer placed between the sub-base course and asphalt paving.

C. Sub-base course: layer placed over the excavated sub-grade in a trench before laying pipe. Layer placed between the sub-grade and base course for asphalt paving, or layer placed between the sub-grade and a concrete pavement or walk.

D. Sub-grade: surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below sub-base, drainage fill, or topsoil materials.

E. Borrow Soils: satisfactory soil imported from off-site for use as fill or backfill as approved by the Geotechnical Engineer.

F. Drainage Course: layer supporting slab-on-grade used to minimize capillary flow of pore water.

G. Excavation: removal of material encountered above sub-grade elevations.

1. Additional Excavation: excavation below subgrade elevations as recommended by Owner's testing agency, and approved by the Engineer/Owner to reach specified compaction level. Additional excavation, replacement, and proof-roll unit costs are to be included in the base contract amount.

2. Bulk Excavation: excavations more than 10 feet in width and pits more than 30 feet in either length or width.

3. Unauthorized Excavation: excavation below sub-grade elevations or beyond indicated dimensions without direction by Owner's testing agency. Unauthorized excavation, as well as remedial work recommended by Owner's testing agency, shall be without additional compensation.

H. Fill Soils: suitable soil materials, as determined by the Owner's testing agency, used to raise existing grades.

I. Rock: rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 C.Y. for bulk excavation or 3/4 C.Y. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted.

1. Excavation of footings, trenches, and pits: late-model, track-mounted hydraulic excavator equal to caterpillar model no. 215d-lc; equipped with a 42-inch wide, short-tip-radius rock bucket; rated at not less than 120-hp flywheel power with bucket-curling force of not less than 25,000 lbf and stick-crowd force of not less than 18,000 lbf; measured according to SAE-J1179.

2. Bulk or open excavation: late-model, track-type tractor, equal to caterpillar model no. D- 8n, rated at not less than 285-hp flywheel and equipped with a single-shank hydraulic ripper, capable of exerting not less than 45,000-lbf breakout force; measured according to SAE-J732.

J. Structures: buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

K. Utilities: Include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings, as applicable.

1.3 SUBMITTALS

A. Product data for the following:

1. Plastic warning tape.

2. Drainage fabric (Non-woven).

3. Separation fabric (Woven).

4. Certified gradation data.

B. Samples: for the following:

1. 12 inch sample of warning tape.

2. 12-by-12-inch sample of drainage fabric.

3. 12-by-12-inch sample of separation fabric.

4. 30-lb samples sealed in airtight containers, of each proposed soil material from on-site or borrow sources and engineered fill materials delivered to geotechnical testing agency for running proctor tests. Document borrow material source(s) for each sample submitted.

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 698 for each on-site or borrow soil material proposed for fill and backfill.

3. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill.

1.4 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. "Pre-Excavation Conference" - conduct conference at project site to comply with requirements in Division 1.

C. "Codes and Standards" - perform earthwork complying with requirements of authorities having jurisdiction.

1.5 PROJECT CONDITIONS

A. Existing Utilities: do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner, and then only after arranging to provide temporary utility services according to requirements indicated:

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

2. Do not proceed with utility interruptions without Owner's written permission.

3. The Ohio utilities protection service (OUPS) does not locate utilities outside public R/W's. The contractor shall employ a qualified utility locating service for all underground utilities on the project.

4. Cut and cap, demolish, and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

5. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult Utility Owner and Engineer immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of the Utility Owner and Owner.

B. Geotechnical report: a subsurface geotechnical investigation report for the site. The opinions expressed in this report are those of the Geotechnical Engineer and represent interpretations of the subsoil conditions, tests, and results of analyses conducted by the Geotechnical Engineer. The Owner will not be responsible for interpretations or conclusions drawn from this data by the contractor. The contractor shall make his or her own investigation of existing subsurface conditions. The Owner, nor the Engineer, will be responsible in any manner for additional compensation for excavation work performed under the contract due to the contractor's assumptions based on soil investigation data prepared by the Owner's geotechnical investigation.

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 soil materials are defined as those complying with American Association of State Highway and Transportation Officials (AASHTO) M145, soil classification Groups A-1, A-2-4, A-2-5, and A-3. Soil classification Group A-6 may be satisfactory if approved by the testing laboratory.

C. Unsatisfactory soil materials are those defined in AASHTO M145 soil classification Groups A-2-6, A-2-7. A-4, A-5, and A-7; also, peat and other highly organic soils.

D. 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 in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. CL can be used if approved by Geotechnical Engineer.

E. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, MH, 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.

F. Backfill and Fill: satisfactory soil materials.

G. Sub-base: material shall comply with the requirements of ODOT Item 304 Aggregate Base.

H. Base: material shall comply with the requirements of ODOT Item 301 Asphalt Concrete Base, and ODOT Item 304 for concrete.

I. Engineered Fill: naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a no. 200 sieve.

J. Bedding: 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 1inch sieve and not more than 8 percent passing a no. 200 sieve.

K. Drainage Fill: washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a no. 8 sieve.

L. Filter Material: narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a no. 4 sieve.

M. Impervious Fill: clayey gravel and sand mixture capable of compacting to a dense state at optimum moisture content.

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 wide and 4 mils 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 a maximum of 30 inches 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.

B. Drainage Fabric: non-woven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and the minimum properties determined by ASTM D 4759.

C. Separation Fabric: woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; and the minimum properties determined according to ASTM D 4759.

D. Erosion-Control Blankets: biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long. Install in detention basin per manufactures recommendations.

E. Erosion-Control Fiber Mesh: biodegradable twisted jute or spun-coir mesh, a minimum of 0.92 lb. /sq. Yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long. Install on slopes greater that 1 Vertical to 3 Horizontal or areas subject to erosion in order to stabilize site.

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 sub-grades 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, walkways, and roadways.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared sub-grades, and from flooding project site and surrounding area. Unsuitable soils as a result of improper dewatering are to be removed and replaced at the General Contractor's expense.

B. Protect sub-grades from softening, undermining, washout, and damage by rain or water accumulation. Unsuitable soils as a result of improper sub-grade protection are to be removed and replaced at the General Contractor's expense.

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 or drainage trench, when necessary to keep sub-grades dry and convey ground water away from excavations in accordance with the recommendations of the geotechnical report. Maintain system until dewatering is no longer required.

3.3 EXPLOSIVES

A. The use of explosives is prohibited.

3.4 EXCAVATION, GENERAL

A. Unclassified excavation: excavation to, and beyond, sub-grade elevations as necessary to reach specified compaction level, regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions. Unclassified excavated material may include rock, soil materials, and obstructions. Changes in the contract sum or the contract time will be authorized in writing by the OWNER for excavation or removal of unclassified material.

B. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials as directed by the Owner's testing agency.

C. Replacement of soils shall be included in both the contract time and contract sum. No adjustments shall be authorized to either component for such occurrences.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch.

B. 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. Do not disturb bottom of excavations intended for bearing surface.

3. Refer to geotechnical report for additional recommendations.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

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

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line, [32" according to OBC 4125.03] unless noted otherwise by the Contract Documents.

C. Excavate trenches to uniform widths, in accordance with OSHA guidelines, to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

D. Trench bottoms: excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape sub-grade 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 sub-grade.

1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple- duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed sub-grade.

2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference.

3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 APPROVAL OF SUB-GRADE

A. Notify Owner's testing agency when excavations have reached required sub-grade.

B. If Owner's testing agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed with written approval of owner.

1. Additional excavation and replacement material included in the General Contractor's sum will be addressed either by unit price or allowance.

C. Proof roll sub-grade with fully loaded, 20 yd tandem dump truck to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated sub-grades. Owner's representative must be present for proof roll.

D. Reconstruct sub-grades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Owner's testing agency.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete or LSM fill may be used when approved by Engineer.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials when and where directed by Owner. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water away. Cover stockpiles to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, or within time as specified by the Contract Documents, but not before completing the following:

1. Construction below finish grade including, where applicable, damp proofing, 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.

3.12 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 of bottom of footings; fill with concrete to elevation of bottom of footings with approval of ENGINEER.

C. Provide 4 inch thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway sub-base.

D. Place and promptly compact initial backfill of sub-base material (to 98% std. proctor), free of particles larger than 1 inch, to a height of 12 inches 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.

E. Coordinate backfilling with utilities testing.

F. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.

G. Place and compact final backfill of satisfactory soil material to final sub-grade.

H. Install warning tape directly above utilities, 12 inches minimum below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 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 3 H to 1 V so fill material will bond with existing material.

C. Place and compact fill material in layers to required elevations at locations as follows:

1. Under grass and planted areas, use satisfactory screened topsoil.

2. Under walks and pavements, use engineered fill or ODOT Item 304.

3. Under steps and ramps, use engineered fill.

4. Under building slabs, use engineered fill.

5. Under footings and foundations, use engineered fill.

3.14 MOISTURE CONTROL

A. Uniformly moisten or aerate sub-grade 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 & replace, or scarify & air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 % and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill 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 std. proctor test ASTM D 698.

1. Unless specified elsewhere, under structures, building slabs, steps and pavements, the compaction should be a minimum of 98 percent of the optimum density.

D. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under walkways, scarify and re-compact top 6 inches below subgrade and compact each layer of backfill or fill material at 98 percent (std. proctor).

2. Under lawn or unpaved areas, scarify and re-compact top 6 inches below sub-grade and compact each layer of backfill or fill material at 95 percent.

3. Top 12" of sub-grade under roadways, drives, parking areas, foundations, backfill, footings, pads, paved pedestrian walks and courts, loading docks and paving primarily for vehicle traffic, the compaction shall be a minimum of 100 percent.

3.16 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 sub-grades to required elevations within the following tolerances:

1. Lawn or unpaved areas: plus or minus 1 inch.

2. Walks: plus or minus 1/2 inch.

3. Pavements: plus or minus 1/2 inch.

C. Grading inside building lines: finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

D. Rough grade lawn area to a maximum of 4 H to 1 V. Steeper grades will require ground cover planting. Provide roundings at top and bottom of banks and at breaks in grade.

E. Scarify sub-grade to a minimum depth of 5 inches before placement of topsoil. Remove all waste material.

F. Minimum depth for compacted screened topsoil shall be 6 inches for grass and adequate depth for other planting materials.

G. Protect newly graded areas from the elements. Repair all settlement and erosion and re-establish grades to the required elevations prior to acceptance.

H. All erosion control must comply with "Rainwater and Land Development – Ohio's Standards for Storm Water Management, Land Development and Urban Stream Protection" for all sediment control, silt fences, storm drain inlet protection, and best management practices (BMP).

I. Refer to SWPP plans for additional information.

3.17 SUB-BASE AND BASE COURSES

A. Under pavements and walks, place sub-base course on prepared sub-grade and as follows:

1. Place base course material over sub-base.

2. Compact sub-base and base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 100 percent of maximum dry unit weight according to ASTM D 698 (std. proctor).

3. Shape sub-base and base to required crown elevations and cross-slope grades.

4. When thickness of compacted sub-base or base course is 6 inches or less, place materials in a single layer.

5. When thickness of compacted sub-base or base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

B. Pavement shoulders: place shoulders along edges of sub-base and base course to prevent lateral movement. Construct shoulders, at least 60 inches wide, of satisfactory soil materials and compact simultaneously with each sub-base and base layer to not less than 100 percent of maximum dry unit weight according to ASTM D 698.

3.18 FIELD QUALITY CONTROL

A. Testing agency: Owner will engage a qualified independent Geotechnical Engineering testing agency to perform field quality-control testing/compliance.

B. Allow testing agency to inspect and test sub-grades and each fill/backfill layer. Proceed with subsequent earthwork only after field test results for previously completed work comply with requirements.

C. Footing Sub-grade: at footing sub-grades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other

footing sub-grades may be based on a visual comparison of sub-grade with tested sub-grade when approved by the Geotechnical Engineer.

D. Testing agency will test compaction of soils in place according to ASTM D 698, 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 sub-grade and at each compacted fill and backfill layer, at least one test for every 5000 S.F. or less of paved area or building slab, but in no case fewer than three tests.

2. Foundation wall backfill: at each compacted backfill layer, at least one test for each 100 feet 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 or less of trench length, but no fewer than two tests.

E. When testing agency reports that sub-grades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten, aerate, or remove and replace soil to depth required; re-compact and retest until specified compaction is obtained.

3.19 PROTECTION

A. Protecting graded areas: protect newly graded areas from traffic, freezing, and erosion. Keep all areas graded to drain, free of ruts, ponding water, trash, and debris. Contractor is to pump off all ponding water immediately. 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 Engineer; reshape and re-compact.

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, as satisfactory to the Owner.

D. Protect areas with slopes exceeding 3 H to 1 V with erosion-control fiber mesh and with erosion-control blankets installed and stapled according to manufacturer's written instructions.

E. Unless noted otherwise, protect areas with slopes not exceeding 3 H to 1 V by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into topsoil with suitable mechanical equipment, use tackifier, or erosion control netting. Maintain during construction.

3.20 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-site.

1. Do not burn or bury removed materials on project site.

2. If hazardous materials are encountered during clearing operations, notify the Engineer for additional instructions. Comply with laws and ordinances concerning removal, handling and protection against exposure or environmental pollution.

END OF SECTION 31 20 00

SECTION 32 12 00 – FLEXIBLE PAVING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work included in this section pertains to all materials, equipment, finishing methods, installation etc. that relate to flexible paving.

1.2 APPLICABLE SPECIFICATIONS

A. The following standards form a part of these specifications:

1. The American Society for Testing Materials Standards (ASTM):

a. C 29 Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate.

b. C 127 Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.

c. D 75 Standard Practice for Sampling Aggregates.

2. ODOT specifications (Ohio Department of Transportation, Construction & Materials Specification. CMS) latest edition:

a. Item 304 Aggregate Base (as amended herein).

b. Item 401 Asphalt Concrete Pavements - General.

c. Item 441 Asphalt Concrete - Mix Design and Quality Control (as amended herein).

d. Item 448 Asphalt Concrete Acceptance.

e. Item 641 Pavement Marking - General.

f. Item 740 Pavement Marking Material.

g. Method of measurement and basis of payment clauses are excluded from this specification reference.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate base shall be in accordance with ODOT Item 304, using crushed limestone only.

B. Intermediate course, when noted, shall be in accordance with ODOT Item 441 – Type 2, using crushed limestone only.

C. Surface course shall be in accordance with ODOT Item 441 – Type 1, using crushed limestone or air cooled blast furnace slag only (no RAP).

D. Gutter sealer shall be in accordance with ODOT Item 705.04.

E. Tack coat shall be in accordance with ODOT Item 407, using MC-70 or MC-250 asphalt emulsion (ODOT Item 702).

F. Application of pavement markings shall be in accordance with ODOT Item 740 Pavement Marking Material.

G. The Owner will engage the services of a testing laboratory to insure compliance with all specifications.

PART 3 - EXECUTION

3.1 PREPARATION

A. Proof-roll prepared sub-base surface with tandem 20 C.Y. dump truck with rock, to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and sub-grade is ready to receive pavement.

B. Owners' representative(s) must be present at time of proof-rolling for proof-roll to be acceptable to Owner/Engineer.

C. Remove loose material from compacted sub-base surface immediately before placing any concrete.

3.2 BASE COURSE

A. Base course shall be constructed to ODOT Item 304 specifications with compacted depths as specified in the Contract Documents.

B. If acceptable to the Owner and Engineer, clean salvaged base course may be used in the bottom 2 inches of new pavement sections.

C. Compaction of base shall be as approved by the testing laboratory.

D. Refer to geotechnical report for additional information.

3.3 LEVELING AND SURFACE COURSES

A. Construction of the asphaltic concrete course shall be in accordance with ODOT specifications. Thicknesses noted on drawings are compacted depths; construct to secure noted depths of blacktop after compaction. Spreading and finishing of open areas shall be done to secure accurate surface grades, which shall conform in all respects to those indicated on grading plan. All gutters and joints at concrete foundations, equipment and drainage grates shall be sealed in accordance with ODOT Item 705.04.

B. The testing laboratory shall test the flexible pavement materials, etc., for compliance with ODOT specifications. Reclaimed materials will not be permitted unless approved by the Engineer. Provide the Owner and Engineer with copies of all test results.

C. Surface tolerances for asphaltic concrete:

1. For vehicular pavements - ODOT Item 401.19.

D. Protect the surface course from vehicular traffic and parking until the pavement has cured.

E. Repair depressions by cutting out the surfacing with vertical cuts to a minimum depth of 1-1/2", filling and rolling. Feathered patches are prohibited.

3.4 VEHICULAR PAVEMENT MARKING

A. Contractor shall lay out and paint pavement markings as indicated on the drawings. Markings shall be painted with one coat in solid lines. Edges shall be straight and clear. All parking space paint lines and directional graphics shall be white in color. All restricted curbs and "no parking areas" shall be painted yellow. All other painted markers shall be in the color shown on the drawings. All markings shall be retro reflective.

END OF SECTION 32 12 00

SECTION 32 13 00 – RIGID PAVING

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Work included in this section pertains to all materials, equipment, finishing methods, installation etc. that relate to rigid paving.

B. This section includes exterior cement concrete pavement for the following:

1. Driveways and Roadways
2. Parking Lots
3. Curbs and Gutters
4. Walkways
5. Curb Ramps
6. Paver Support
7. Dumpster Area

1.2 DEFINITIONS

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

1.3 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:

1. ODOT Item 451 Reinforced Portland Cement Concrete Pavement
2. ODOT Item 452 Non-Reinforced Portland Cement Concrete Pavement
3. ASTM C 33 – Standard Specification for Concrete Aggregate
4. ASTM C 39 – Compressive Strength of Cylindrical Concrete Specimens
5. ASTM C 94 – Ready Mix Concrete

6. ASTM C 873 – Compressive Strength of Concrete Cylinders Cast In Place in Cylindrical Molds

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. Fiber reinforcement.

4. Admixtures.

5. Curing compounds.

6. Applied finish materials.

7. Bonding agent or adhesive.

8. Joint fillers.

E. Minutes of pre-installation conference.

1.4 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 if required by engineer.

G. Preinstallation conference: conduct conference at project site

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

1.5 PROJECT CONDITIONS

A. Traffic control: maintain access for vehicular and pedestrian traffic as required by Owner and Engineer for other construction activities.

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 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. Epoxy-coated welded wire fabric: ASTM A 884/A 884M, class A coated, plain steel.

D. Reinforcement bars: ASTM A615/A 615M, grade 60, deformed (carbon steel bars).

E. Epoxy-coated reinforcement bars: ASTM A 775/A 775M; with ASTM A 615/a 615M, grade 60, deformed bars.

F. Steel bar mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, grade 60, deformed bars; assembled with clips.

G. Plain steel wire: ASTM A 1064/A 1064M-16b, as drawn.

H. Joint dowel bars: plain steel bars, ASTM A 615/A 615M, grade 60. Cut bars true to length with ends square and free of burrs.

I. Epoxy-coated joint dowel bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, grade 60, plain steel bars.

J. Tie bars: ASTM A 615/a 615M, grade 60, deformed.

K. 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.

2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer coated wire bar supports and chairs adequate to support weight of concrete, installers, and prevent displacement or misalignment.

L. Epoxy repair coating: liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.

2.3 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.

2. Air cooled blast furnace slag: ODOT 703.01, 703.02.

C. Blended hydraulic cement: ASTM C 595, type is, Portland blast-furnace slag cement.

D. Blended hydraulic cement: ASTM C 595, type I Portland pozzolan cement.

E. Blended hydraulic cement: ASTM C 595, type I (pm) pozzolan-modified Portland cement.

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

1. Class: 4s, 4m, or 1n.

2. Maximum aggregate size: 3/4 inch nominal.

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

G. Water: ASTM C 94.

2.4 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. Chemical Admixtures for concrete:

1. Water-reducing admixture: ASTM C 494, type A.

2. Water-reducing and retarding admixture: ASTM C 494, type D

3. Water-reducing and accelerating admixture: ASTM C 494, type E.

4. Water-reducing High-range, admixture: ASTM C 494, type F.

2.5 CURING MATERIALS

A. Absorptive cover: AASHTO M 182, class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./S.Y. Dry.

B. Moisture-retaining cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: potable.

D. Evaporation retarder: waterborne, monomolecular film forming, manufactured for application to fresh concrete.

E. Clear solvent-borne liquid-membrane-forming curing compound: ASTM C 309, type 1, class b.

F. Clear waterborne membrane-forming curing compound: ASTM C 309, type 1, class b.

G. White waterborne membrane-forming curing compound: ASTM C 309, type 2, class b.

H. Products: subject to compliance with requirements, provide one of the following:

1. Evaporation Retarder:

a. Finishing Aid Concentrate; Burke Group, LLC.

b. Sure Film; Dayton Superior Corporation.

c. Eucobar; Euclid Chemical Co.

d. Confilm; Master Builders, Inc.

2. Clear Solvent-Borne Liquid-Membrane-Forming Curing Compound:

a. Res-X Cure All Resin; Burke Group, LLC.

b. Day-Chem Rez Cure; Dayton Superior Corporation.

c. Kurez DR; Euclid Chemical Co.

d. 3100-Clear; W. R. Meadows, Inc.

3. Clear Waterborne Membrane-Forming Curing Compound:

a. Aqua Resin Cure; Burke Group, LLC.

b. Day Chem Rez Cure (J-11-W); Dayton Superior Corporation.

c. 1100 Clear; W. R. Meadows, Inc.

4. White Waterborne Membrane-Forming Curing Compound:

a. Aqua Resin Cure; Burke Group, LLC.

b. 1200-White; W. R. Meadows, Inc.

2.6 RELATED MATERIALS

A. Expansion-and isolation-joint-filler strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Provide type 1, type 2, type 3, or type 4 as specified in ODOT specifications, section 740.01 and section 740.02.

C. Glass beads: AASHTO M 247.

D. Wheel stops: precast, air-entrained concrete; 3000-psi minimum compressive strength. Provide chamfered corners and drainage slots on underside, and provide holes for dowel-anchoring to substrate.

1. Dowels: galvanized steel, epoxy coated, diameter of 3/4 inch, minimum length.

E. Slip-resistive aggregate finish: factory-graded, packaged, rustproof, non-glazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

F. Bonding agent: ASTM C 1059, type ii, non-redispersible, acrylic emulsion or styrene butadiene.

G. Epoxy bonding adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:

1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 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. Mix designs are to comply with ODOT CMS requirements.

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, unless noted otherwise.

2. Flexural strength (28 days); 650 psi.

3. Maximum water-cementitious materials ratio: 0.45.

4. Slump limit: 4 inches.

    a. Slump limit for concrete containing high-range water-reducing admixture: not more than 8 inches after adding admixture to plant, or site-verified, 3-inch 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. Cementitious materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows, and in accordance with ODOT item 499.03-02:

1. Fly Ash: 25%

2. Ground Granulated Blast-Furnace Slag (GGBFS): 30%

3. Micro-Silica: 10%

4. When using multiple pozzolans materials, do not exceed the individual maximum contents above for each material. A combination of pozzolans materials may not exceed 50% of the total cementitious content by weight.

F. 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: 5.5 percent for 3/4-inch maximum aggregate.

G. Coloring agent: add coloring agent to mix according to manufacturer's written instructions.

2.8 CONCRETE MIXING

A. Ready-mixed concrete: comply with manufacturers' requirements and with ASTM C 94.

B. Ready-mixed concrete: comply with manufacturers' requirements and with ASTM C 94 and ASTM C 1116.

1. When air temperature is between 85 deg f and 90 deg f, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg f, reduce mixing and delivery time to 60 minutes.

C. Project-site mixing: comply with requirements and measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixers of 1 C.Y. or smaller capacity, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.

2. For mixers of capacity larger than 1 C.Y., increase mixing time by 15 seconds for each additional 1 C.Y.

3. Provide batch ticket for each batch discharged and used in the work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added.

2.9 FIBER REINFORCEMENT

A. Synthetic fiber: fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, type iii, ½ to 1-1/2 inches long.

PART 3 - EXECUTION

3.1 PREPARATION

A. Proof-roll prepared sub-base surface with tandem 20 C.Y. dump truck with rock, to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and sub-grade is ready to receive pavement.

B. Owners' representative(s) must be present at time of proof-rolling for proof-roll to be acceptable to Owner/Engineer.

C. Remove loose material from compacted sub-base surface immediately before placing any 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 or discoloration.

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.

1. Apply epoxy repair coating to uncoated or damaged surfaces of epoxy-coated 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 at all times.

D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.

3.4 JOINTS

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.

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 into concrete.

2. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.

3. Provide tie bars at sides of pavement strips where indicated.

4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

5. Use epoxy bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

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 adjacent to structures and fixed anchorage points.

2. Extend joint fillers full width and depth of joint.

3. Terminate joint filler less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.

4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.

5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. 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.

2. Sawed joints: form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

E. Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt- coat one-half of dowel length to prevent concrete bonding to one side of joint.

F. Edging: tool edges of slabs, gutters, and curbs 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.

3.5 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 sub-base surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten sub-base 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. Box out around MH frame and grates. Install expansion joints.

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, "Guide for Consolidation of Concrete".

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. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.

1. Remove and replace portions of bottom layer of concrete that have been placed more than 15 minutes without being covered by top layer, or use bonding agent if approved by Engineer.

I. 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.

J. Curbs and gutters:

1. When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements to the Engineer. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

2. Curbs: all curbs shall match called out curbing on Contract Documents. Cast-in-place concrete

shall be used unless other design is required to match existing conditions. Comply with ODOT items 499 and 609. Concrete shall be class QC using no. 57 aggregate at 600 lbs. per C.Y. Slump shall be a maximum of 4 inches and minimum 28-day strength shall be 4000 psi with 4 to 8 percent entrained air.

a. Expansion joints shall be specified and shall be shown on the drawings. Color of the joint sealer shall match that of the concrete.

b. Four inch under drains in porous backfill shall be installed under all combination curbs and gutters. Under drains shall extend to the nearest feasible drainage basins. Combination curb and gutter may be used only to match or repair existing work.

K. Walks: For commercial projects thickness shall be 8 inches over 4 inches of compacted no. 304 limestone gravel base unless directed otherwise by the Engineer. Nominal 2" x 6" wood forms should be used. The concrete shall have tooled edges which are then disguised by a light/medium broom finish. Except where required for structural purposes, reinforcing bars or welded wire fabric should be omitted unless otherwise specified by the Contract Documents. For conventional concrete walks, use ODOT class QC concrete with clean natural sand, limestone aggregate, and 4 to 7 percent entrained air.

1. Curing compounds: specify only non-staining type. It has been found that clear chlorinated rubber compounds cause staining which cannot be removed.

L. Curb ramps for persons with disabilities: see the ADAAG 4.7.

1. Companion ramps: state laws require that when a curb ramp is built on one side of a street, a companion ramp is required on the opposite side of the street. When project limits would normally end within a street intersection, the limits must be extended to allow construction of a companion ramp on the far side of the intersection. For projects in which federal funding is involved, this requirement must carefully be coordinated with federal requirements regarding limits of federal participation.

M. Slip-form pavers: when automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements to the Engineer. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.

1. Compact sub-base and prepare sub-grade of sufficient width to prevent displacement of paver machine during operations.

N. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 75 percent of its 28-day compressive strength.

O. Cold-weather placement: comply with ACI 306R-16 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, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.

2. Do not use frozen materials or materials containing ice or snow.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

P. Hot-weather placement: place concrete according to recommendations in ACI 305R-10 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. 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 sub-grade just before placing concrete. Keep sub-grade moisture uniform without standing water, soft spots, or dry areas.

Q. Concrete paving:

1. Metal nosings on exterior stairs are prohibited.

2. Stairs, rails and cheek walls, slopes to drain. Any stairs should be kept to a minimum. Ramps are to be used whenever possible within ADAA guidelines.

3. All sidewalks, stairs and ramps must withstand vehicular loading.

4. Where not noted on drawings, curbs to match adjacent 6 inch x 18 inch curb or verify with Engineer.

5. Use concrete for walkways, drives, service courts, parking areas, dumpster pads, compactor pads, loading dock ramps, aprons, and bus pull offs. All items shall be designed for particular items and be verified by the Engineer.

6. Radiused intersections shall be poured monolithic and should extend to the outer limits of the curves. Segmented curves are prohibited.

7. Cross slope of all walks shall be 1/4 inch per foot.

8. Walks abutting buildings shall bear on the foundation or be dowelled.

9. The full width of sidewalks adjacent to curbs shall be 1/4 inch above the curb.

10. Temperature steel in stair nosings must have a minimum of 1-1/2" of concrete cover.

11. Contractors are required to wet sub-base prior to placing the concrete.

12. Curbs shall be poured concrete with #5 top and bottom reinforcing and without gutters. Provide contraction joints at 15 ft. max intervals. Filler strips must be specified.

    a. Dropped curbs for drive and handicapped access shall be formed for all new work.

    b. Remove existing curb back to nearest existing joint when new curbs extend into existing curb lines.

    c. Paving base should extend a minimum of 6 inches beyond the edge of the surface if curbs are not provided.

13. Combined fire service/sidewalks shall be designed to accommodate Fire Department's largest vehicles' (minimum 12 ft. wide) turning radius and provisions for outrigger support.

3.6 CONCRETE FINISHING

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. Re-float surface immediately to uniform granular texture.

C. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float- finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.7 CONCRETE PROTECTION AND CURING

A. General: protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1-90 for cold-weather protection and follow recommendations in ACI 305.1-6 for hot-weather protection during curing.

B. Evaporation retarder: apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb. /S.F. before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Curing methods: cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.

   b. Continuous water-fog spray.

   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's requirements. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.8 PAVEMENT TOLERANCES

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

1. Elevation: 1/4 inch.

2. Thickness: Plus 3/8 inch, minus 1/4 inch.

3. Surface: Gap below 10-foot long, unleveled straightedge not to exceed 1/4 inch.

4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.

5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.

6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.

7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.

8. Joint Spacing: 3 inches.

9. Contraction Joint Depth: Plus 1/4 inch, no minus.

10. Joint Width: Plus 1/8 inch, no minus.

3.9 WHEEL STOPS

A. Securely attach wheel stops into pavement with not less than two galvanized steel, epoxy coated dowels embedded in holes cast into wheel stops. Firmly bond each dowel to wheel stop and to pavement. Extend upper portion of dowel 5 inches into wheel stop and lower portion a minimum of 18 inches into pavement.

3.10 FIELD QUALITY CONTROL

A. Testing agency: Owner will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this section.

B. Testing Services: Testing shall be performed according to the following requirements:

1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C 172, except modified for slump to comply with ASTM C 94.

2. Slump: ASTM C 143; one test at point of placement for each compressive-strength test, but not less than one test for each day's pour of each type of concrete. Additional test will be required when concrete consistency changes.

3. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air-entrained concrete.

4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of compressive- strength specimens.

5. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.

6. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 C.Y., but less than 25 C.Y., plus one set for each additional 50 C.Y. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.

7. When frequency of testing will provide fewer than five compressive-strength tests for a given class of concrete, testing shall be conducted from at least five randomly selected batches, or from each batch if fewer than five are used.

8. When total quantity of a given class of concrete is less than 50 C.Y., Engineer may waive compressive-strength testing if adequate evidence of satisfactory strength is provided.

   a. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.

   b. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 psi.

C. Test results shall be reported in writing to Owner/Engineer, 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 Engineer and Owner 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 Engineer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this section with characteristics exceeding those specified in this specification.

B. Drill test cores where directed by Owner/Engineer 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.

E. Refer to Storm Water Pollution Prevention Plan (SWPPP) for additional information.

END OF SECTION 32 13 00

SECTION 32 17 23 – PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 WORK INCLUDES

A. The work under this section includes all labor, materials, equipment and services to mark parking stalls, traffic lanes and other markings as shown on the drawings or hereinafter specified, or both, and in accordance with the current ODOT Item 641, Pavement Marking-General.

1.2 QUALITY ASSURANCE

A. Qualifications: the Contractor performing work under this section shall be qualified to do such work and hold the appropriate registration, license or other permit as required by state or local law.

B. Requirements of regulatory agencies: Contractor shall procure all permits and licenses, pay all charges and fees, and give all notices necessary and incidental to the due and lawful prosecution of the work. All pavement markings shall conform to the requirements of the Ohio Manual of Uniform Traffic Control Devices.

1.3 SUBMITTALS

A. Submit the following:

1. Evidence or affidavit which certifies that material to be used complies as specified.

2. Material safety data sheet for each material to be used on the project.

1.4 JOB CONDITIONS

A. Site inspection: Contractor to familiarize himself with the site, the drawings, the specifications and drawing requirements and is responsible to call any discrepancies to the attention of the Engineer before proceeding with any work.

B. Environmental requirements: clean tools and equipment only where the residue will not harm or mark the soil, plants or structures.

C. Scheduling: contractor to coordinate his work with that of other contractors to ensure efficient and orderly progress of the work, in accordance with the general requirements.

PART 2 – PRODUCTS

2.1 PAVEMENT MARKINGS

A. All pavement markings shall conform to ODOT Item 641. Parking lot lines shall be white. Arrows, islands, and words shall be yellow.

B. All directional arrows, cross walks, stop bars, etc. shall be thermoplastic and be in accordance with ODOT Item 644. Painted pavement striping will be reapplied approximately 6 months after initial application.

2.2 TRAFFIC PAINT

A. Provide type 1 and type 2, as specified in ODOT specifications section 740.01 and section 740.02, yellow and white as indicated on the Contract Documents.

B. Store paint in accordance with local regulations and the manufacturer's recommendations. Provide adequate protection and security of the materials.

PART 3 - EXECUTION

3.1 GENERAL

A. If required, extent and location of pavement marking shall be indicated by the Engineer.

B. Apply pavement marking in accordance with ODOT Items 641, and 642.

3.2 PREPARATION

A. Sweep surface with power broom supplemented by hand brooms to eliminate loose material and dust.

3.3 INSTALLATION

A. Lines and arrows shall be accurately measured and chalk lined as to location, direction and length before being painted.

B. Control lines for locating stalls shall be verified with the Engineer prior to any painting operation.

C. Thermoplastic products are to be applied in strict accordance with the manufacturer's recommendations.

D. Lines painted with a mechanical striper capable of providing continuous painted lines 4 inches in width with uniform straight edges.

E. Handicap symbols are to be painted using templates according to applicable standards.

3.4 CLEAN-UP

A. Upon completion of the work, Contractor shall perform clean-up as necessary, eliminating any incorrectly painted lines or spills by paint remover or painting over with blending color, and leaving the area in a neat and finished condition acceptable to the Engineer and Owner.

END OF SECTION 32 17 23

SECTION 32 1723.13 – PAINTED PAVEMENT MARKINGS (INSIDE DECK)

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Parking stall striping and cross lines.

1.02 RELATED SECTIONS:

A. Section 033816- Unbonded Post Tensioned Concrete.

B. Section 033900- Concrete Curing

C. Section 071800- Traffic Coatings

D. Section 071900- Water Repellents

E. Section 079200- Joint Sealants

1.03 QUALITY ASSURANCE:

A. Qualifications of Applicator: The applicator shall be experienced in this type of work. The applicator shall submit evidence of such experience, including a list of projects in which the work was similar in scope and quality to that specified.

1.04 JOB CONDITIONS:

A. Existing Conditions: Examine work in place on which this work is dependent. Defects which may influence satisfactory completion and performance of this work shall be corrected in accordance with the requirements of the applicable section of work prior to commencement of the work. Commencement shall be construed as work in place being acceptable for satisfying the requirements of this section.

B. Protection: Protect the work and adjacent work against damage during progress of work. Construction equipment which will damage existing or new pavement, shall not be used.

PART 2 – MATERIALS

2.01 PAVEMENT MARKING PAINT:

A. All material shall meet the Type I requirements of Federal Specification TT-P-1952-B for paints.

B. Color of Paint – Yellow

1. The paint shall visually match color chips of Federal Standard 595B, when a wet film thickness of 0.015 inch thickness is applied to a tin panel and let dry for 24 hours.

C. Acceptable striping paints are:

1. "Latex Traffic Paint" Glidden Paint; Cleveland, Ohio
    a. No. 22685 Yellow
2. "Dura Clad Latex Traffic Paint", Duron, Inc. Beltsville, MD.

a. No. TM225 Yellow

3. "Setfast Acrylic Latex Traffic Paint", Baltimore Paint and Chemical Company; Division of the Sherwin-Williams Co., Baltimore, Maryland.

a. Yellow

D. Glass Beads: AASHTO M 247, Type 1 made of 100% percent recycled glass.

PART 3 – EXECUTION

3.01 PREPARATION

A. Painted surfaces shall be clean and dry. Remove dirt, oil, grease, stains and other substances. Protect surfaces from dampness before application of paint.

3.02 APPLICATION

A. Parking Stall Paint:

1. Paint lines mechanically on bituminous paving with one coat of traffic paint in the locations shown on the drawings.
2. Apply traffic paint to a minimum net film thickness of 15 mils in lines 4 inches wide.
3. Wavy or lines with ragged edges will not be accepted.

END OF SECTION

SECTION 33 14 00 – WATER UTILITY TRANSMISSION AND DISTRIBUTION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide water utility transmission and distribution system components and other work, as required in these specifications, on the Contract Documents, and as otherwise deemed necessary to complete the work.

1.2 REFERENCE STANDARDS

A. American Society For Testing And Materials (ASTM):

1. B 32 – Standard Specification for Solder Metal.

2. B 88 – Standard Specifications for Seamless Copper Water Tube.

3. B 813 – Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.

4. D 2122 – Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.

5. D 3139 – Standard Specifications for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

6. D 3350 – Standard Specifications for Polyethylene Plastic Pipe and Fittings Materials.

7. F 477 – Standard Specifications for Elastomeric Gaskets for Joining Plastic Pipe.

8. F 714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.

B. American Water Works Association (AWWA):

1. C 104/ANIS A21.4-Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

2. C 105/ANIS A21.5-Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

3. C 111/ANIS A21.11-Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

4. C 151/ANIS A21.51-Standard for Ductile-Iron Pipe, Centrifugally Cast.

5. C 153/ANIS A21.53-Standard for Ductile-Iron Compact Fittings.

6. C 502 Dry Barrel Fire Hydrants.

7. C 504 Rubber-Seated Butterfly Valves 3 In. (75 mm) through 72 In. (1,800 mm).

8. C 509 Resilient-Seated Gate Valves for Water Supply Service.

9. C 515 Reduced-Wall, Resilient Seated Gate Valves for Water Supply Service.

10. C 550 Protective Interior Coatings for Valves and Hydrants.

11. C 651 Disinfecting Water Mains.

12. C 800 Underground Service Line Valves and Fittings.

13. C 900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings (4 In. through 12 In.) for Water Transmission and Distribution.

14. C 905 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. through 48 In. (350 mm through 1,200 mm).

15. C 906 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm through 1,650 mm), for Waterworks.

C. Submittals

1. Provide manufacturers product information (cut sheets) and O&M information for water main materials including:

   a. Pipe

   b. Fittings

   c. Valves

   d. Hydrants

   e. Joint restraint materials

2. Provide copies of all pressure and electric continuity testing procedures and results for the project to the Owner's project representative and the Engineer within 48 hours of completing the individual tests and obtaining the results from said tests.

3. Provide reports that document safe sample collection procedures and results.

4. Continuity of existing water distribution system

5. Provide a construction schedule to Engineer, municipal water utility (if applicable) and local fire department (if applicable) for review and approval prior to starting construction. Schedule shall indicate the date and time of all required water supply interruptions.

6. Do not interrupt existing water supply without approval from Owner's/Engineer's project representative, municipal water utility, and local fire department.

7. Once approved, notify all distribution system users impacted by outages a minimum of 48 hours in advance of outage. Notification shall be provided in writing and describe the nature and duration of outages, and provide the name and number of Contractor's foreman or other contact.

1.3 PROVISIONS FOR FUTURE WORK

A. Construct water main system in a manner that will facilitate future extension or connection.

B. Unless otherwise shown on the Contract Drawings, provide valves on "dead end" mains that will allow dry connection to the water main system. Terminate "dead end" mains with full length of pipe beyond the valve, and a bell end with restrained plug.

C. As-built drawings: show the actual locations of water main and services, valves and hydrants on drawings and show changes to proposed water main size, alignment, or grades. Show the actual locations, sizes and types of underground utilities and other features encountered during construction.

PART 2 - MATERIALS

2.1 DUCTILE IRON WATER MAIN

A. Ductile iron water main shall be class 53, AWWA C 151 / ANIS A21.51 centrifugally cast, cement mortar lined meeting the requirements of AWWA C 104 / ANIS A21.4.

B. Ductile iron water main joints shall be rubber gasket push-on joint or mechanical joint meeting the requirements of AWWA C 111 / ANIS A21.11.

C. Pipe shall be provided with conductive bonding straps to provide electrical continuity.

D. Pipe shall be manufactured in the United States.

2.2 PVC WATER MAIN

A. Polyvinyl chloride pipe shall have a dimension ratio (DR) of 18 or less and conform to the requirements of AWWA C 900 (4"-12") or AWWA C 905 (14"-48"). Pipe shall meet applicable NSF standards for use in a potable water distribution system.

B. PVC water main joints shall be rubber gasket push-on joint conforming to ASTM D 3139, using a gasket that conforms to ASTM F 477.

2.3 HDPE WATER MAIN

A. Polyethylene resin used for manufacturing piping and fittings shall meet ASTM D 1248 for type iii, class C, grade P34, category 5, with a PPI recommended designation of PE3408 and a minimum cell classification of PE 345434C in accordance with ASTM D 3350. The polyethylene compound shall be combined with carbon black to provide protection against degradation by ultraviolet light. Pipe shall be made from virgin material with no rework compound, except that obtained from the manufacturer's own production of the same formulation.

B. High density polyethylene (HDPE) piping, shall meet the requirements of AWWA C 906, current version. Pipe dimensions and workmanship shall be in accordance with ASTM F 714 and ASTM D 2122. Pipe shall be of diameter shown on the Contract Drawings, with dimension ratio (DR) of DR 11, unless otherwise noted.

2.4 PIPE, FITTINGS, AND JOINTS SHALL MEET OR EXCEED THE FOLLOWING PHYSICAL PROPERTIES

Property	ASTM Test Method	Value
Density (gm/cc)	D 1505	0.955
Melt Index (gm/10 min)	D 1238-e	0.10
High Load Melt Index (gm/10min)	D 1238-f	12.0
Tensile Strength @ break (psi)	D 638	4,500
Tensile Strength at Yield (psi)		>3,200
Elongation (%)		>800
Flexural Modulus (psi)	D 790	136,000
Environmental Stress Cracking Resistance f_{20}' hours (100°C)	D 1693 (cond. C)	> 5,000
Brittleness Temperature (°F)	D 746	<-180
Melting Point (°F)	D 789	261
Vicat Softening Temperature (°F)	D 1525	255
Hardness (Shore d)	D 2240	66
Volume Resistivity (ohm-cm)	D 991	$2.6\ 10^{16}$
Recommended Hydrostatic Design Stress	-	1600 psi @ 73.4 °F 800 psi @ 140 °F

2.5 PIPE MARKING

A. Each length of straight and special HDPE pipe and fitting shall be plainly marked on the outside to identify the design pressure or class of pipe, proper location of the pipe or fitting in the pipeline, and the date of manufacture.

2.6 COPPER WATER SERVICE

A. Below ground 2 ½" and smaller.

B. Type K copper water tube, O (annealed) temper, ASTM B 88; with cast copper pressure fittings, ANIS B 16.18; wrought copper pressure fittings, ANIS B 16.22; lead free (<.2%) solder, ASTM B 32; flux, ASTM B 813; or cast copper flared pressure fittings, ANIS B16.26.

2.7 DUCTILE-IRON WATER MAIN FITTINGS

A. Fittings shall be Ductile-Iron cement mortar lined mechanical joint compact style fittings meeting the requirements of AWWA C 153 / ANIS A21.53.

B. Fittings shall be manufactured in the United States.

2.8 POLYETHYLENE FITTINGS

A. HDPE fittings manufactured in accordance with ASTM D 2683 (socket fused) or ASTM D 3261 (butt fused). Fittings shall be supplied by the HDPE piping manufacturer. Butt fusion outlets shall be made to the same dimensional characteristics and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe. Pressure de-rated fabricated fittings are prohibited.

2.9 VALVES

A. Resilient wedge gate valve

1. Resilient seated wedge gate valve meeting the requirements of AWWA C 509 and C 515. Body, bonnet and gate shall be constructed of Ductile-Iron. Bolts shall be stainless steel.

2. Interior and exterior surfaces of valve shall be provided with epoxy coating meeting the requirements of AWWA C 550. Symmetrical wedge shall be completely encapsulated with resilient material.

3. Valve stem shall be non-rising, low-zinc (zinc content not to exceed 6%) bronze. Valve stem shall have an integral thrust collar. Thrust collar bearings shall be designed to withstand maximum torque without distortion.

4. Stem seal shall be so designed that the O – ring above the stem collar can be replaced while the valve is under pressure and in the fully open position.

5. Valve shall be left opening and be provided with standard 2" square operating nut.

6. Valve shall be provided with mechanical joint connections. Mechanical joint ends shall conform to AWWA C 509 and shall be furnished complete with all mechanical joint accessories including approved M.J. bolts and nuts. Glands shall be full body gray iron or ductile iron. Mechanical joint bells, glands, and rubber gaskets shall be in accordance with AWWA C 111.

7. Mueller, Kennedy, U.S. Pipe, American Flow Control, Clow, or approved equal.

B. Butterfly valve

1. Rubber-seated butterfly valve meeting the requirements of AWWA C 504, for class 150B. Body and disc shall be constructed of ductile iron. Bolts shall be stainless steel. Disc shall be lens shaped.

2. Interior and exterior surfaces of valve shall be provided with epoxy coating meeting the requirements of AWWA C 550. Disc shall be provided with a stainless steel disc edge.

3. Valve stem shall be stainless steel. Packing shall be permanent duty "Chevron V-type" or "O-ring" type. Bearings shall be permanent, non-metallic, and self-lubricating.

4. Valve seat shall be a single piece of elastomeric material that is not penetrated by the valve shaft.

5. Provide manual operator that is suitable for underground service and includes a standard 2" square operating nut.

6. Valve shall be provided with mechanical joint connections. Mechanical joint ends shall conform to AWWA C 509 and shall be furnished complete with all mechanical joint accessories including approved M.J. bolts and nuts. Glands shall be full body gray iron or ductile iron. Mechanical joint bells, glands, and rubber gaskets shall be in accordance with AWWA C111.

7. Mueller, Henry Pratt, Kennedy, or approved equal.

C. TAPPING VALVE

1. Resilient seated wedge gate tapping valve having 100% port, and meeting the requirements of AWWA C 509 and C 515. Body, bonnet and gate shall be constructed of Ductile-Iron. Bolts shall be stainless steel.

2. Interior and exterior surfaces of valve shall be provided with epoxy coating meeting the requirements of AWWA C550. Symmetrical wedge shall be completely encapsulated with resilient material.

3. Valve stem shall be non-rising bronze. Stem collar shall be provided with thrust bearings that are protected by upper and lower O-ring seals both above and below.

4. Valve shall be left opening and be provided with standard 2" square operating nut.

5. Valve shall be provided with flange connection on inlet side of valve and mechanical joint connections on outlet side of valve. Mechanical joint end shall conform to AWWA C 509 and shall be furnished complete with all mechanical joint accessories including approved M.J. bolts and nuts. Glands shall be full body gray iron or Ductile-Iron. Mechanical joint bells, glands, and rubber gaskets shall be in accordance with AWWA C 111.

6. Provide suitable companion tapping sleeve.

7. Mueller, U.S. Pipe, American Flow Control, Clow, or approved equal.

2.10 BRASS WATER SERVICE FITTINGS

A. Service saddles

1. Double strap, bronze service saddles meeting the requirements of AWWA C 800. Service saddles shall be provided with nitrile O-ring gasket and AWWA taper outlet.

2. Service saddles shall be properly sized to accommodate both the main, and service lines.

3. Mueller br 2b series, Ferguson, Romac, or approved equal.

2.11 CORPORATION STOPS

1. Corporation stops shall be brass, ball style. Inlets shall be AWWA taper; outlet connection shall be compression having a positive indicator to avoid over-tightening.

2. Corporation stops shall be Mueller b-25008, A.Y. Mcdonald Mfg. Co., or approved equal.

2.12 CURB STOPS

A. Curb stops shall be brass, with compression connections having a positive indicator to avoid over-tightening. Curb stops shall be provided with a quarter turn check.

B. Curb stops shall be Mueller b-25209, A.Y. Mcdonald Mfg. Co., or approved equal.

2.13 UNIONS

A. Unions shall be 3-piece brass, with compression connections having a positive indicator to avoid over-tightening.

B. Unions shall be Mueller h-15403, A.Y. Mcdonald Mfg. Co., or approved equal.

2.14 U-BRANCH, WYES, ETC.

A. U-branch, wye and other fittings shall be brass, with compression connections having a positive indicator to avoid over-tightening. Fittings shall be produced specifically for water supply applications.

B. Mueller, A.Y. Mcdonald Mfg. Co., or approved equal.

2.15 VALVE BOXES

A. Gate/butterfly valve boxes

1. Valve boxes shall be screw type and shall consist of a base, middle section, top section with cover and intermediate extension sections. The top section shall be designed to thread onto the middle section so that the unit can be adjusted to a variable length. The top section shall be designed to receive a circular drop cover.

2. The valve box and component parts shall be cast iron in accordance with ASTM A 48 class 20, 30, 35, or approved equal.

3. Boxes shall be 5-1/4" with stay-put "Water" cover.

4. The cast iron valve box and components shall be free from blowholes, cold shots, shrinkage defects, cracks or other injurious defects and shall have a normal smooth casting finish.

5. All cast iron valve boxes and components shall be thoroughly coated with asphaltic pitch varnish or approved equal.

6. Provide valve box extensions as necessary to accommodate depth of cover shown on drawings, or 6.5-foot minimum.

7. Valve boxes shall be Bingham & Taylor, East Jordan Iron Works, Tyler, or approved equal.

a. Curb stop boxes

1) Curb stop boxes shall be 1 1/4" minimum diameter, cast iron, arch style, valve boxes. Boxes shall be telescopic, extendable to accommodate 7' bury. Lid shall be two piece threaded, with a plug having a pentagonal bolt for removal.

2) Provide valve box extensions as necessary to accommodate depth of cover shown on drawings, or 6.5-foot minimum.

3) Ford, Mueller, or approved equal.

2.16 HYDRANTS

A. Fire hydrants shall be dry-bury type meeting the requirements of AWWA C 110, C 111, and C 502.

B. Hydrants shall be Ductile-Iron, 250 psi rated working pressure.

C. Hydrants shall be traffic rated as specified in AWWA C 502 except which is modified to permit a complete 360 degree rotation, or any increment thereof.

1. Hydrants shall be provided with the following features:

a. 7' bury (6.5' cover over lead)

b. 6" mechanical joint inlet

c. 5 ¼" main valve opening. Verify with local FD

d. One 4 ½" pumper nozzle with national standard threads. Verify with local FD

e. Two 2 ½" hose nozzles with national standard threads. Verify with llocal FD

f. Nozzle caps with chains

g. Pentagon operating nut, open counter-clockwise, conforming to AWWA C 502. Material of the operating nut shall be either hardened bronze or Ductile-Iron.

h. Painted red. Painting shall be in accordance with AWWA C 502. Verify with local FD.

D. All extensions shall be made for insertion below the breakable flange. Extensions shall be made from the same material as that of the barrel. The hydrant must be designed to allow the use of barrel extension kits, which allow the raising of the hydrant to a new grade while retaining the "safety coupling and breakable flange" traffic collision feature at the new grade. Extension kits are to be in 6" increments, with the shortest being 6" long.

E. All nozzles shall be at the same elevation. Nozzle shall be capable of being threaded into the upper barrel and shall be mechanically locked in place. The distance from the base of the operating nut to the center of the pumper nozzle shall not be less than 7-1/8". The distance between the ground and the center of the pumper nozzle shall not be less than 15 inches nominal dimension.

F. Hydrant shall be Waterous, Mueller, U.S. Pipe, or approved equal. Verify with local FD.

2.17 JOINT RESTRAINTS

A. Retainer glands for Ductile-Iron pipe

1. Ductile-Iron wedge action retainer glands designed for use with Ductile-Iron pipe.

2. Glands shall be constructed of. Restraint shall be provided by a minimum of three

wedges that are tightened onto the exterior of the pipe using a threaded, torque limiting mechanism.

3. Glands shall be tested to provide restraint at 250 psi operating pressure.

4. Ebaa Iron, Mueller Aquagrip, Romac Romagrip, or approved equal.

B. Retainer glands for PVC pipe

1. Wedge action retainer glands designed for use with PVC pipe.

2. Glands shall be constructed of Ductile-Iron. Restraint shall be provided by a minimum of four wedges that are tightened onto the exterior of the pipe using a threaded, torque limiting mechanism.

3. Glands shall be tested to provide restraint at 200 psi operating pressure.

4. Retainer glands shall be mega-lug by Ebaa Iron, or approved equal.

5. Ebaa Iron, Mueller Aquagrip, Romac Romagrip, or approved equal.

2.18 POLYETHYLENE ENCASEMENT BAG

1. 8-mil polyethylene encasement bag meeting the requirements of AWWA C 105 / ANIS A21.5, class "C" black.

2.19 BOARD INSULATION

A. Insulation shall be rigid, closed-cell extruded polystyrene insulation suitable for buried installation. Individual boards shall have minimum dimensions of 8'x4'x2".

B. Owens Corning, Dow Styrofoam, or approved equal.

2.20 TRACER WIRE

A. Tracer wire shall be #10 solid copper wire with insulated jacket. Tracer wire insulation color for non-metallic, potable water pipe shall be blue. Tracer wire insulation color for non-metallic, non- potable water pipe shall be purple.

2.21 LOCATOR TAPE

A. Tape shall be detectable metallic locator tape, specifically manufactured for marking utilities with a minimum width of 6 inches and detectable at a depth of 18".

B. Tape for potable water shall be marked "water" and blue colored. Tape for non-potable water shall be marked "non-potable water" and purple colored.

2.22 CHLORINE

A. Chlorine disinfectant shall be calcium hypochlorite tablets or granules. Calcium hypochlorite product shall meet requirements for AWWA C 651 – Standard for Disinfecting Water Mains - latest revision.

B. Arch "HTH", or approved equal.

2.23 PIPE JOINT LUBRICANT

A. Petroleum free pipe lubricant formulated for use with potable water systems. Product shall meet the requirements of AWWA C 111 / ANIS A21.11 - latest revision.

PART 3 - EXECUTION

3.1 GENERAL

A. Complete exploratory excavations at utility crossings as shown on the Contract Drawings, and as necessary to complete the work.

B. Maintain clearances between water mains and existing or proposed sewer lines as follows:

1. 10' horizontal separation (measured center to center) between water mains and existing or proposed sanitary or storm sewers.

2. 18" vertical separation (measured from outsides of pipes) where water mains cross over and under sanitary or storm sewers.

C. Notify the Engineer of utility conflicts before proceeding with construction.

D. Store and handle pipe in accordance with manufacturers' recommendations. Keep pipes clean of soil, debris and animals.

E. Water main construction shall be completed in a manner that minimizes interruptions to existing services.

F. If service interruptions are necessary to install improvements, notify the Owner and obtain written permission a minimum of 48 hrs prior to service interruption.

3.2 CONNECTIONS TO EXISTING WATER MAINS/TAPPING

A. Provide tapping sleeves, valves, cutting-in sleeves and other materials specifically manufactured for use with the type of pipe to which the connection is being made.

B. Notify the Engineer if the proposed point of connection is located within 4' of an existing joint.

C. Connections shall be made at existing pipe stubs, valves or other fittings.

D. At connections to existing mains, locate the new valve as close to the existing main as possible. Swab the interior surfaces of all pipe, fittings, valves that will be exposed to the existing system. Swab solution shall consist of a 5% (by weight) solution of calcium hypochlorite.

3.3 BEDDING / UTILITY COVER

A. Provide bedding and utility cover in accordance with the applicable requirements.

B. Water main and water service piping shall be provided with 6" of bedding material and 12" of utility cover material (both measured at the bell of the pipe).

C. Bedding and cover material for various types of pipe shall consist of the following.

1. Ductile-Iron water main: bedding sand or crushed stone screenings.

2. PVC Water main: crushed stone bedding.

3. Copper water services: bedding sand or crushed stone screenings.

3.4 LAYING WATER MAIN

A. Install pipe in accordance with the AWWA and ASTM specifications that pertain to the specified type of pipe material and the installation situation.

B. Provide a minimum of 5' of cover over water main, unless otherwise shown on the Contract Drawings or directed by the Engineer. For water mains with less than 5' of cover, provide insulation as shown on the Contract Drawings, or as directed by the Engineer.

C. Lay water main at uniform grades between deflection points shown on the drawings; do not install water mains with intermediate high points.

D. Unless otherwise shown or approved by the Architect/ Engineer, lay pipe with bell end facing the direction of pipe laying.

E. For Ductile-Iron water main, place polyethylene encasement bag on water main prior to lowering into trench. Once pipe is joined, pull bag over entire length of pipe, overlap joint at adjacent pipe and secure using "duct" tape or other approved method.

F. Prepare pipe bell and gasket in accordance with manufacturers requirements. Lubricate bell and/or pipe with AWWA/NSF approved lubricant.

G. Push pipe home in accordance with manufacturer's recommendations regarding tools and methods.

H. Pipe joint deflection shall not exceed manufacturer's requirements.

I. For Ductile-Iron pipe, connect bonding straps or lugs to provide electrical continuity along entire water main. Provide exothermic weld to attach new bonding straps, when existing straps are missing or damaged. Follow manufacturer's requirements for exothermic welding procedures.

J. Locate the geographic location of all dead end water mains and services and note actual location on as-built drawings.

K. Disinfect pipe by placing calcium hypochlorite in each section of pipe as pipe laying progresses. Provide dosage as indicated on table 33 11 00-1.

Water main nominal diameter (inches)	Dose calcium hypochlorite* (oz./length pipe)
4-6	1
8	3

10	5
12	7

* Granular/tablet calcium hypochlorite with 68% (weight) available chlorine
Table 33 11 00-1

L. When required, provide board insulation in the thickness and width shown on the drawings. Unless otherwise shown, insulation shall be provided at a minimum thickness of 2 inches.

M. Install insulation on compacted initial cover material 6 inches above the top of pipe. Stagger joints when placing multiple layers of insulation.

N. Provide insulation with a minimum of 1 foot of utility cover material. Place backfill material in manner that does not damage insulation; replace damaged insulation.

3.5 TRACER WIRE

A. Provide tracer wire for buried non-metallic water piping. Tracer wire shall be installed directly above the top of pipe and within 6 inches of the pipe.

B. Splices in tracer wire shall be made with split-bolt or compression-type connectors.

C. Access points are required every 400 feet. At access points the tracer wire shall be brought to grade in valve boxes, utility structures or other covered access devices.

3.6 LOCATOR TAPE

A. Install locator tape directly above new non-metallic sanitary sewer pipe approximately 15 inches below finished grade. Bring tape to surface and terminate in valve box or other structure.

3.7 FITTINGS, VALVES AND HYDRANTS

A. Install fittings, valves, and hydrants at locations shown on the Contract Drawings.

B. Unless otherwise shown, provide restrained mechanical joint connections. Install materials in accordance with manufacturer's recommendations.

C. Maintain electrical continuity through all fittings, valves and hydrants. Provide and install suitable jumper cables for epoxy coated valves.

D. Place hydrants and valves on 4"x8"x16" solid concrete masonry units set on compacted soil.

E. Install joint restraints in accordance with the manufacturer's requirements.

F. Install valve box so that bonnet rests on compacted initial backfill material at the same elevation as the top of the valve stuffing box. Center the valve box over the valve nut.

G. Install valve box plumb and level, backfilling evenly. Extend valve box to proposed final grade; provide valve box extensions as necessary. Valve boxes that shift during backfilling or restoration shall be excavated and re-set.

H. Mark all valve boxes with a steel "u" fence post to protect them from damage.

I. Install hydrants at elevations shown on Contract Drawings, or as required to provide a minimum of 6.5' cover over the hydrant lead.

J. Place approximately 1/2 C.Y. of clear stone bedding material from the base of the hydrant to 6 inches above the drain holes on the hydrant elbow. Cover clear stone material with a "skirt" of polyethylene encasement bag material to prevent backfill material from migrating into the clear stone.

K. Install hydrant plumb and level, backfilling all sides evenly.

L. Cover all new hydrants with a plastic garbage bag or similar cover until the main has been filled and placed in service.

3.8 JOINT RESTRAINT

A. Unless otherwise noted, all fittings, valves and hydrants shall be installed with restrained joints. Joint restraints shall be used on the adjacent full length (or more lengths as shown on the Contract Drawings) of pipe on all sides of fittings. Additionally, branch runs of pipe shall be installed with restrained joints beginning at the fitting at the main to the first valve.

B. Hydrant leads shall be provided with restrained joints beginning at the fitting at the main to the hydrant.

C. Joint restraint shall be provided using retainer glands (Mega Lugs or approved equal).

D. Install all joint restraint products in accordance with manufacturer's recommendations and Contract Drawings.

3.9 COPPER WATER SERVICES AND BRASS FITTINGS

A. Connect copper water service piping to water main, wellhouse, or other supply as shown on the Contract Drawings.

B. Water main taps shall be made under pressure using a tapping machine specifically designed to tap and install corporation stops. Dry water main taps are not allowed.

C. Service saddles shall installed on services where the corporation stop is 1 ½" nominal diameter or greater.

D. Provide a horizontal offset adjacent to the main for all copper services. Comply with pipe manufacturer's requirements with respect to minimum radius on bends.

E. Install curb stops as shown on the Contract Drawings. If specific curb stop location is not shown on the Contract Drawings, consult with the Engineer to determine acceptable location prior to installing.

F. Place curb stop box on a 4"x8"x8" solid concrete masonry unit set on compacted ground. Orient box so that no portion of the box bears on the water service or curb stop.

G. Install curb stop box plumb and level and backfill all sides simultaneously. Extend curb stop box to proposed final grade; provide extensions as necessary. Curb stop boxes that shift during backfilling or restoration shall be excavated and re-set.

H. Install copper water service as shown on the Contract Drawings. Prepare copper pipe joints in accordance with pipe and fitting manufacturer recommendations. Cut pipe squarely, remove burs and round ends as necessary.

I. Install fittings in accordance with manufacturer's recommendations. Torque compression connections to recommended tightness; do not over-tighten compression joints.

J. Provide dead-end copper water services with compression connectors fitted with plugs. Do not tap or crimp the ends of copper water services shut.

K. Locate the geographic location of all dead end services and curb stop boxes and note actual location on as-built drawings.

3.10 FILLING WATER MAIN

A. Fill water main after main has been installed and completely backfilled.

B. Fill main slowly to limit entrapped air and evenly distribute calcium hypochlorite. Open all hydrants completely to allow air to escape and monitor filling.

C. Once main is full, allow a minimum of 48 hours of time for disinfection to occur before flushing.

3.11 PRESSURE TESTING

A. Pressure test all water main and where applicable copper water services. In accordance with the NFPA Testing requirements and AWWA standards.

B. Provide all valves, fittings, joint restraints, hoses, compressors, water and power supply as necessary to complete pressure testing. Utilize testing apparatus that is fabricated specifically for testing water mains. Calibrate pressure gauges as necessary.

C. Flush main as necessary to remove air prior to testing. Comply with the requirements of this section with respect to flushing.

D. For longer installations or installations consisting of water main and copper water service, the contractor may elect to pressure test the system in short segments.

E. All pressure testing shall be conducted in the presence of the Engineer. Provide minimum of 48 hours advanced notice of testing.

F. Conduct a combined pressure/leakage test for 1 hour at a pressure equal to 150% of system normal operating pressure (as measured at the lowest point in the system), or a minimum pressure of 150 psig.

G. When conducting test, pressure test equipment shall be set-up as close to the highest point in the line as possible.

H. Make-up water for the test shall be clean potable water supplemented with 1/2 oz of dry calcium hypochlorite per 35 gallons of water.

I. Leakage for test shall not exceed gallons per hour as allowed by the following formula:
$G=(nd\sqrt{p})/7400$

Where: G = allowable leakage (gallons per hour of test) n=number of joints under test
d=nominal diameter of main (inches) p=average pressure during test (psig)

2. Allowable leakage for high density polyethylene pipe shall be zero.

J. Record and document pressure test by recording the following information:

1. Date of test.

2. Section tested.

3. Diameter and length of main under test.

4. Number of fittings, valves hydrants, etc.

5. Results of test including test length, pressure, actual water loss.

6. Calculation of allowable leakage.

7. If a failed test, describe actions taken to eliminate leaks and results of re-testing.

K. Submit reports documenting pressure testing to the Engineer.

3.12 ELECTRIC CONTINUITY TESTING

A. Conduct electric continuity test on all Ductile-Iron wate rmain and copper water services.

B. The electric continuity test shall be performed using a multi-meter to verify electrical continuity of the water main system.

C. The Contractor shall furnish all labor and equipment necessary to conduct the electric continuity test.

D. Document electric continuity testing by recording the following information:

1. Date of test.

2. Test methods and equipment.

3. Section tested.

4. Diameter and length of main under test.

5. Number of fittings, valves hydrants, etc.

6. Results of test including resistance.

7. If a failed test, describe actions taken to eliminate leaks and results of re-testing.

E. Submit reports documenting electric continuity testing to the Engineer.

3.13 DISINFECTION/FLUSHING

A. Perform in accordance with AWWA standards.

B. After filling the main, allow a minimum of 48 hours of time for disinfection to occur before flushing.

C. Flush all sections of water main and water service. When possible, utilize hydrants or other large diameter orifices to complete flushing and achieve 2.5 fps water velocity. If needed, utilize services or temporary connections to complete flushing.

D. All water main and services shall be flushed for a minimum of 10 minutes, or as necessary to obtain a sediment-free and bacteriologically safe sample.

E. Utilize diffusers, hoses, settling basins and other devices as necessary to limit erosion and other damage to the site and downstream areas.

F. Contractor shall be responsible for providing all necessary fitting, valves, joint restraints, hydrants and other materials necessary to conduct flushing.

G. Submit reports documenting disinfection and flushing to the Engineer.

3.14 BACTERIOLOGICAL SAMPLE

A. Following all pressure testing and flushing, the Contractor shall collect a sample from the newly installed water main or water service(s). Samples shall be submitted to the state laboratory of hygiene, or other licensed testing laboratory for bacteriological (coliform bacteria) analysis.

B. The Contractor shall be responsible for all costs associated with sample collection(s) and analysis.

C. Document bacteriological sample collection and analysis by recording the following information:

1. Date of sample collection.
2. Sample collection methods and equipment.
3. Person collecting the sample.
4. Location(s) sample was collected.
5. Results of sample analysis.

D. If sample results indicate water is "unsafe – coliform bacteria present", Contractor shall re-disinfect water main and water services by introducing additional chlorine into the line and re-flushing the main. This process shall be repeated as necessary until a clean sample is obtained. The contractor shall be responsible for all costs associated with all efforts necessary to obtain a "safe – coliform bacteria not present" sample.

E. Submit reports documenting bacteriological sample collection and analysis to the Engineer.

END OF SECTION 33 14 00

SECTION 33 30 00 – SANITARY SEWERAGE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section specifies the requirements for furnishing and placing sanitary sewer pipe, laterals, stubs, and appurtenances. The pipe shall be of the size, type and location, and to the lines, grades and elevations shown on the Construction Documents and constructed in accordance with these specifications.

1.2 APPLICABLE PUBLICATIONS

The following publications of the latest issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto.

A. American Society for Testing and Materials Standards (ASTM).

1. A 48 Specification for Gray Iron Castings.

2. A 615 Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

3. A 746 Standard Specification for Ductile Iron Gravity Sewer Pipe.

4. C 33 Standard Specification for Concrete Aggregates.

5. C 76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

6. C 150 Standard Specification for Portland Cement.

7. C 443 Specification for Joints for Concrete Pipe and Manholes Using Rubber Gaskets.

8. C 476 Specification for Grout for Masonry.

9. C 478 Specification for Circular Precast Reinforced Concrete Manhole Sections.

10. C 969 Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.

11. D 2241 PVC Pressure-Rated Pipe (SDR Series).

12. D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

13. D 3034 Specification for Polyvinyl Chloride (PVC) Pipe and Fittings.

14. D 3212 Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

15. F 477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

16. F 679 Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

17. F 1417 Standard Test Method for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air.

B. American Water Works Association (AWWA)

1. C 105 Polyethylene Encasement for Ductile-Iron Pipe Systems.

2. C 110 Standard for Ductile-Iron and Gray-Iron Fittings.

3. C 111 Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

4. C 600 Installation of Ductile Iron Water Mains and Their Appurtenances.

C. American Concrete Institute (ACI)

1. ACI 318 Building Code Requirements for Structural Concrete

1.3 SUBMITTALS

A. Product Data:

1. Corrosion proof liner selected for protecting concrete pipe from sewer gases. Contractor shall submit data on the selected liner for approval prior to construction (Concrete Lining).

2. Any Special pipe fittings as detailed in the Contract Documents.

B. Shop Drawings:

1. Cast in Place Manholes: Include plans, elevations, sections, details, design calculations, concrete design-mix report, frames, and covers.

2. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between manholes, piping, and proximity structures.

3. Field Quality Control Test Reports

1.4 DEFINITIONS

A. ABS: Acrylonitrile-Butadiene-Styrene Plastic.

B. FRP: Fiberglass-Reinforced Plastic.

C. LLDPE: Linear Low-Density, Polyethylene Plastic.

D. PE: Polyethylene Plastic.

E. PP: Polypropylene Plastic.

F. PVC: Polyvinyl chloride Plastic.

G. TPE: Thermoplastic Elastomer.

H. DI: Ductile-Iron Pipe.

1.5 PROJECT CONDITIONS

A. When working with sanitary manholes new or existing, Contractor must keep requirements for confined space entries. In all activities, Contractor shall work in a safe manner as required by OSHA and other governing criteria.

1. If work requires interference with any public sewer systems within or outside of Public Rights of Way or Easements, Contractor must obtain prior approval and coordinate with local municipality before commencing work.

1.6 DELIVERY STORAGE AND HANDLING

A. Contractor is responsible for protecting materials per manufactures recommendations

1. Do not store plastic, pipe and fittings in direct sunlight.

2. Protect pipe, pipe fittings and seals from dirt and damage. Handle and store pipe, and fittings in accordance with manufacturers recommendations.

3. Handle cast in place manholes according to manufacturer's written rigging instruction.

PART 2 - PRODUCTS

2.1 PIPE

A. PVC pipe, 6" to 10" shall conform to ASTM D 3034, SDR 26. PVC pipe 12" and 15" shall conform to ASTM D 3034, SDR 35. PVC pipe 18" to 27" shall conform to ASTM F 679, SD 35. All diameters shall use bell and spigot ends for gasketed joints with ASTM F 477 elastomeric seals. For sewers up to 12" diameter crossing over or under waterlines, provide minimum 150 psi pressure rated pipe conforming to ASTM D 2241 with suitable PVC couplings.

2.2 JOINTS

A. PVC pipe joints shall conform to ASTM D 3212.

2.3 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, 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

a. Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter or other substances injurious to the finished product.

b. Water sources other than the local municipal domestic water supply must be approved by the Owner/Engineer.

c. If onsite reclaimed water sources are used, tanks and other appurtenances must be clearly marked with the words "non-potable" water.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

C. Reinforcement Bars: ASTM A 615, Grade 60 deformed steel.

D. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

a. Invert Slope: 1 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 8 percent.

E. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

2.4 MANHOLES

A. Precast concrete manholes shall conform to ASTM C 478.

B. Ballast: Increase thickness of concrete as required to prevent flotation.

C. Resilient Pipe Connectors: ASTM C 923 cast or fitted into manhole walls, for each pipe connection.

D. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.

E. Grade Rings: Reinforced-concrete rings, 6 to 9 inch total thickness, to match diameter of manhole frame and cover.

F. Manhole Frames and Covers: To meet those detailed in the detail section of the Contract Documents as specified with precast concrete manholes.

2.5 MORTAR

A. Mortar for flowline directioning in all manholes shall conform to ASTM C 476.

2.6 CLEANOUTS

A. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

B. Available Manufacturers

1. Canplas Inc.

2. IPS Corporation.

3. NOS Inc.

4. Zurn Commercial Specialty Plumbing Products; Zurn Plumbing Products Group.

PART 3 - EXECUTION

3.1 PIPE SEWERS

A. No pipe shall be installed in the trench until excavation has been properly constructed per the Contract Documents to at least two (2) pipe lengths beyond the section of pipe being installed and the bottom of the trench has been properly shaped.

B. Batter boards, where used, shall be placed into position properly. Boards shall be nominal 1 x 4 inch lumber, planed on all four sides to parallel faces. The boards and all location stakes must be protected from injury or change of location.

C. Pipe shall be laid so that after the sewer is completed, the interior surface shall conform accurately to the grades and alignments fixed and given in the Contract Documents.

D. All sewers must be laid accurately to line and grade, with tongue or spigot end downstream.

E. Pipes shall be fitted together and matched so that when laid, they form a sewer with a smooth and uniform invert.

F. Before laying pipes a sufficient bed shall be prepared at the grade indicated on the Contract Documents. Backfill shall be placed in accordance with backfill requirements.

G. A minimum clearance of 6 inches must be maintained between the sewer and all other lines. Sanitary sewers shall not be routed over water lines without approval from the Engineer.

H. Sanitary sewers shall not be constructed within 10 ft. (outside to outside) parallel to a water line. Where sanitary sewers cross under water lines, the pipe material for the sewer shall be an 18 ft. length of ductile iron pipe or PVC schedule 80 pressure pipe, centered on the water line.

I. When trenches exceed five (5) feet in depth, the Contractor shall utilize trench safety measures.

3.2 MANHOLES

A. Manholes shall be constructed at locations and depths indicated on the Contract Documents.

B. Manholes may be constructed of concrete or precast concrete sections and in all types shall be constructed to the dimensions shown on the Contract Documents. Where concrete or precast concrete sections are used, the interior wall shall be thoroughly coated with coal tar epoxy or approved equal.

C. Joints between precast concrete sections shall be made by uniformly placing gaskets equal on all faces of the lower part of the joint and lowering the upper ring evenly into place to produce uniform bearing and compression on the sealer.

D. The construction of manholes shall be done as soon as practical after sewer lines into or through the manhole are completed.

E. All sewers shall be cut neatly at the inside face of the walls of the manhole pointed up with mortar.

F. After the masonry work has been completed to the proper elevation, the cast iron manhole cover/frame shall be set in a full mortar bed and adjusted to the elevation established on the Contract Documents.

G. The inverts of the sewer line or several sewer lines entering the manhole at or near the flow line elevation of the manhole shall be shaped and routed across the floor of the manhole using mortar to obtain the proper contour.

H. When sanitary sewer pipes enter a manhole 2 ft. or greater above the bottom of the manhole, a drop pipe of equal diameter shall be constructed outside the manhole to the bottom of the manhole per the details on the Contract Documents.

I. All manholes are to be backfilled properly.

3.3 FRAMES, GRATES, RINGS AND COVERS

A. Castings shall conform to the types shown on the Contract Documents and shall be clean castings, free from sand or blow holes or other defects. Materials shall be not less than Class 30B gray iron conforming to ASTM A 48.

B. Surfaces of the castings shall be free from burnt-on sand and shall be reasonably smooth.

C. Bearing surfaces between manhole rings and covers/frames shall be cast or machined with such precision that uniform bearings shall be provided throughout the perimeter area of contact.

3.4 FIELD

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of project.

1. Submit separate report for each system inspection.

2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.

b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter or mandrel test per xxxxx.

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. Re-inspect and repeat procedure until results are satisfactory.

4. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

5. Do not enclose, cover, or put into service before inspection and approval have taken place.

6. Test completed piping systems according to requirements of authorities having jurisdiction.

7. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

8. Submit separate report for each test.

B. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

1. Allowable leakage is maximum of 50 gal. /inch of nominal pipe size per mile 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 C 600, "Hydrostatic Testing" Section. Use test pressure of at least 10 psig.

C. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, and the following:

1. Option: Test plastic gravity sewer piping according to ASTM F 1417.

2. Leaks and loss in test pressure constitute defects that must be repaired.

3. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

D. Manhole tests: Test sanitary manholes according to requirements of authorities having jurisdiction, and the following:

1. Option: Vacuum testing:

a. Install vacuum tester head assembly at top access point of manhole and adjust for proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to recommended maximum inflation pressure; do not over-inflate.

b. Evacuate manhole with vacuum pump to 10 inches mercury (Hg), disconnect pump, and monitor vacuum for time period specified in Table 02533-4, Vacuum Test Time Table.

c. A manhole passes the test if after 2 minutes and with all valves closed, the vacuum is at least 9 inches of mercury (Hg).

2. Option: Perform hydraulic test according to ASTM C 969

3. Leaks and loss in test pressure constitute defects that must be repaired.

4. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 33 30 00

SECTION 33 42 00 – STORM WATER CONVEYANCE

PART 1 - GENERAL

1.1 WORK INCLUDES

A. This section includes storm drainage outside the building.

1.2 DEFINITIONS

A. PVC: Polyvinyl Chloride Plastic.

B. ASTM: American Society of Testing and Materials.

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

D. ODOT CMS: Ohio Department of Transportation Construction and Material Specifications (latest edition)

1.3 PERFORMANCE REQUIREMENTS

A. Gravity-flow, non-pressure-piping pressure ratings: at least equal to system test pressure.

1.4 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.

2. Cast-in-place concrete manholes and other structures, including frames, covers, and grates.

B. Design mix reports and calculations: for each class of cast-in-place concrete.

C. Field test reports: indicate and interpret test results for compliance with performance requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight. Store in accordance with manufactures requirements.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle pipe, precast concrete manholes and other structures according to manufacturer's written rigging, unloading & storage instructions.

1.6 QUALITY ASSURANCE

A. Comply with the requirements of authorities having jurisdiction and manufacturer's requirements

1.7 PROJECT CONDITIONS

A. Site information: perform site survey, research public utility records, and verify existing utility locations as required by Ohio Revised Code 153.64.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing utilities: do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary utility services according to requirements indicated:

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

2. No utility interruptions are allowed without the Owner's written permission.

3. Contractor is to include known utility interruptions in project schedule.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All manufacturers are subject to compliance with requirements, specifications, and construction details, and must demonstrate compliance through appropriate test and documentation.

2.2 PIPING MATERIALS

A. If a specific type of pipe is specified on the drawings, the specified type must be used. If a type of pipe is not specified, one of the following shall be provided:

1. Ductile Iron Pressure Pipe: AWWA C 151, Class 52 for push-on joints.

2. Reinforced Concrete Sewer Pipe and Fittings: ASTM C 76, Class III, Wall B, for rubber gasketed joints.

3. Polyvinyl Chloride (PVC): ASTM D 3034, SDR 35, or ASTM F 949 for solvent cemented or gasketed joints.

4. Aluminized Steel: Type 2 per AASHTO M 36 or ASTM A 760 with gasketed joints or bell and spigot joints.

5. Polyethylene Pipe: AASHTO M 252 or M 294; Type S or Type SP or ASTM F 2648; solid or perforated.

2.3 MANHOLES

A. Manholes shall conform to ODOT item 611 and Contract Documents. All MH's shall be HS-20 traffic bearing.

B. ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.

1. Diameter: 48 inches inner diameter minimum, unless otherwise indicated on the Contract Drawings.

2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as

required to prevent flotation.

3. Base Section: 6-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.

4. Riser Sections: 5-inch minimum thickness, and lengths to provide depth indicated.

5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.

6. Gaskets: ASTM C 443, rubber.

7. Grade Rings: Include two or three reinforced-concrete rings, of 6-to 9-inch total thickness, that match 24-inch diameter frame and cover.

8. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod (grade 60) complying with ASTM A 615/A 615M, ASTM C 478, and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into base, riser, top section, and sidewalls with steps at 16 inch intervals on center.

9. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

C. Cast-in-place concrete manholes: constructed of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for a-16, heavy-traffic, and structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Ballast: Increase thickness of concrete, as required to prevent flotation.

2. Grade Rings: Include two or three reinforced-concrete rings, of 6-to 9-inch total thickness, that match 24-inch diameter frame and cover.

3. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod (grade 60) complying with ASTM A 615/A 615M, ASTM C 478, and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into base, riser, top section, and sidewalls with steps at 16 inch intervals on center.

D. Manhole frames and covers: ASTM A 536, grade 60-40-18, Ductile-Iron castings designed for heavy-duty service. Include 24-inch i.d. by 7-to 9-inch riser with 4-inch minimum width flange, and 24-inch diameter cover. Include indented top design with lettering "Storm Sewer" cast into cover. All fames and grates within R/W shall comply with AHJ's requirements.

E. Manhole covers shall be heavy duty Ductile-Iron and include utility designation in the casting.

2.4 CATCH BASINS

A. Normal-traffic, precast concrete catch basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.

1. Base Section: 6-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.

2. Riser Sections: 5-inch minimum thickness.

3. Gaskets: ASTM C 443, rubber.

4. Grade Rings: Include two or three reinforced-concrete rings, of 6-to 9-inch total thickness.

5. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod (grade 60) complying with ASTM A 615/A 615M and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 16 inch intervals on center.

6. Steps: ASTM C 478, individual steps or ladder.

7. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

8. All grates shall be bicycle wheel proof, and those located in accessible ways shall be ADA compliant.

B. Cast-in-place concrete, catch basins: constructed of reinforced concrete; designed according to ASTM C 890 for structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Bottom, Walls, and Top: Reinforced concrete.

2. Channels and Benches: Concrete.

3. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod (grade 60) complying with ASTM A 615/A 615M and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 16 inch intervals on center.

C. Frames and grates: ASTM A 536, grade 60-40-18, ductile iron designed for heavy-duty service.

1. Size: 24 by 24 inches minimum, unless otherwise indicated.

2. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

D. Catch basin, area and yard drain covers in accessible ways shall be ADA compliant and bicycle wheel proof. Covers shall also be safe for shoes with narrow heels (1/4" gap maximum).

E. Existing catch basins that are to be abandoned in place shall be filled with low strength mortar (LSM). All storm pipes to be abandoned are to be plugged with LSM unless noted otherwise.

2.5 STORMWATER INLETS

A. Curb inlets: vertical curb opening, of materials and dimensions indicated on Contract Drawings.

B. Gutter inlets: horizontal gutter opening, of materials and dimensions indicated. Include heavy- duty frames and grates.

C. Combination inlets: vertical curb and horizontal gutter openings, of materials and dimensions indicated. Include heavy-duty frames and grates.

D. Frames and grates: dimensions, opening pattern, free area, and other attributes indicated.

1. Material: ASTM A 536, Grade 60-40-18 minimum, ductile-iron casting.

2. Material: ASTM A 48, Class 30 minimum, gray-iron casting.

3. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

2.6 CONCRETE

A. General: cast-in-place concrete according to 03 30 00.

1. Cement: ASTM C 150, Type II.

2. Fine Aggregate: ASTM C 33, sand.

3. Coarse Aggregate: ASTM C 33, crushed gravel.

4. Water: Potable.

B. Portland cement design mix: 4000 psi minimum, with 0.45 maximum water-cementitious ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.

2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Structure channels and benches: factory or field formed from concrete. Portland cement design mix, 4000 psi 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: as noted on the Contract Documents.

b. Benches: Concrete, sloped to drain into channel.

1) Slope: 8 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: as noted on the drawings.

D. Ballast and pipe supports: Portland cement design mix, 3000 psi 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, deformed steel.

2.7 CLEANOUTS

A. Gray-iron cleanouts: ASME A112.36.2m, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug. Use units with top-loading classifications according to the following applications:

1. Light Duty: In earth or grass foot-traffic areas.

2. Medium Duty: In paved foot-traffic areas.

3. Heavy Duty: In vehicle-traffic service areas.

4. Extra-Heavy Duty: In roads.

5. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC cleanouts: pvc body with pvc threaded plug. Include pvc sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.8 DRAINS

A. Gray-iron area drains: ASME A112.21.1m, round, gray-iron body with anchor flange and round, secured, gray-iron grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated. Use units with top-loading classifications according to the following applications:

1. Medium Duty: In paved foot-traffic areas.

2. Heavy Duty: In vehicle-traffic service areas.

B. Gray-iron trench drains: ASME A112.21.1m, 6-inch wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular, secured grate. Include units of total lengths indicated and number of bottom outlets with inside calk or spigot connections, of sizes indicated. Use units with top-loading classifications according to the following applications:

1. Medium Duty: In paved foot-traffic areas.

2. Heavy Duty: In vehicle-traffic service areas.

3. Extra-Heavy Duty: In roads.

C. Steel trench drains: fabricated from ASTM A 242/A 242 M steel plate, to form rectangular body with uniform bottom slope of 1% min. to 2 % down toward outlet, anchor flange, and grate. Include units of total lengths indicated, bottom outlet of size indicated, outlet strainer, and acid- resistant enamel coating on inside and outside surfaces. Include grate openings with total free area at least two times outlet cross-sectional area and with the following features:

1. Plate Thickness: 1/4 inch.

2. Overall Width: 12-1/2 inches.

3. Grate: 3-by-3/8-inch slots.

4. Cover: Solid with diamond pattern, if indicated.

5. Weep holes in body and flashing clamping ring for units used with waterproof membrane.

D. Special drains: in stairwells, areaways and similar locations where leaf clogging of conventional drains may be expected provide scupper-type drains at the junction of the wall and pavement or walk.

2.9 PIPE OUTLETS

A. Pipe outlet structure shall conform to ODOT item 611.

B. Head walls: ODOT item 611, cast-in-place reinforced concrete, with apron and tapered sides, conforming to standard construction drawings.

C. Rock channel protection: ODOT item 601.09, Type C, with geotechnical fabric, unless specified otherwise.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 312000 section "Earth Moving".

3.2 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, and per the requirements.

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 on the Contract Drawings.

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 Contract Drawings.

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.

F. Comply with manufacturer's requirements for installation.

3.3 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: join and install pipe and fittings according to installations indicated.

1. Install PE film, pipe encasement over hubless cast-iron soil pipe and fittings according to ASTM A 674 or AWWA C105.

B. Install with top surfaces of components, except piping, flush with finished surface.

C. PVC sewer pipe and fittings as follows:

1. Join pipe and gasketed fittings with gaskets according to ASTM F 477.

2. Install according to ASTM D 2321.

D. Concrete pipe and fittings: install according to ACPA'S "Concrete Pipe Installation Manual."

E. System piping joints: make joints using system manufacturer's couplings, unless otherwise indicated.

F. 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.

3.4 MANHOLE INSTALLATION

A. General: install manholes, complete with appurtenances and as required by ODOT Item 611.

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 above finished surface elsewhere, unless otherwise indicated.

D. Install precast concrete manhole sections with gaskets according to ASTM C 891.

3.5 CATCH-BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated and as required by ODOT Item 611.

B. Set frames and grates to elevations indicated.

3.6 STORM DRAINAGE INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as required by ODOT Item 600/611.

B. Construct riprap of stone, as indicated. Install with geotextile fabric, ODOT Item 712.09, Type B.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.

3.7 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so finished work complies as nearly as practical with requirements specified for new work.

B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

C. Make branch connections from side into existing piping, nps 4 to nps 20. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

D. Make branch connections from side into existing piping, nps 21 or larger, or to underground structures by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

1. Use concrete that will attain minimum 28-day compressive strength of 4,000 psi, unless otherwise indicated.

2. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

E. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.8 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned piping: close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.

2. Close open ends of piping with threaded metal caps, plastic plugs, concrete, or other acceptable methods suitable for size and type of material being closed. Usage of wood plugs is prohibited.

B. Abandoned structures: excavate around structure as required and use one procedure below:

1. Remove structure and close open ends of remaining piping

2. Remove top of structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

3. Backfill to grade according to Division 31 Section "Earthwork."

3.9 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 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. Re-inspect and repeat procedure until results are satisfactory.

END OF SECTION 33 42 00