

CONTRACT DOCUMENTS

VOLUME III OF III

MEMORIAL PARKWAY TREATMENT PLANT IMPROVEMENTS

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FORT THOMAS, KENTUCKY

JULY 2006



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SPECIFICATIONS

FOR

NORTHERN KENTUCKY WATER DISTRICT

Memorial Parkway Treatment Plant Improvements

JULY 2006

RON LOVAN, PRESIDENT/CEO

COMMISSIONERS:

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ANDREW COLLINS - SECRETARY
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PAT SOMMERKAMP - COMMISSIONER
FRANK JACKSON - COMMISSIONER
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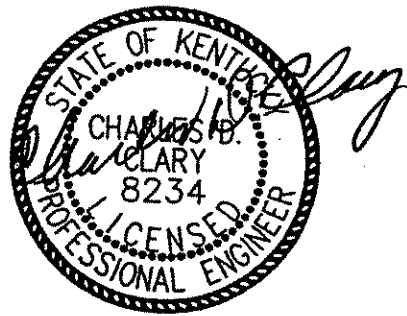
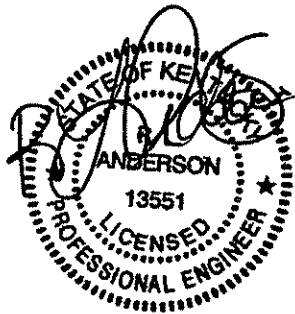
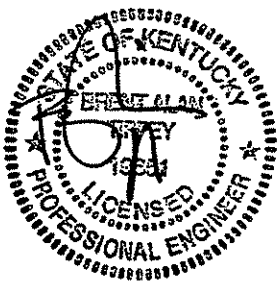
CHARLES PANGBURN - ATTORNEY



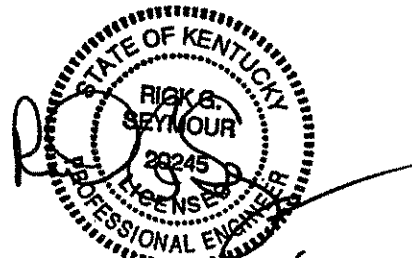
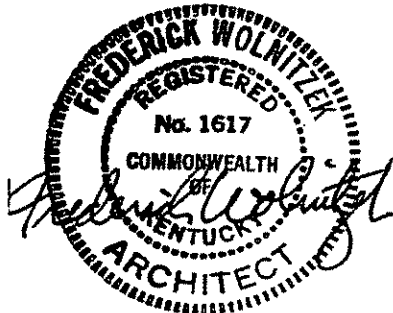
MEMORIAL PARKWAY TREATMENT PLANT IMPROVEMENTS

NORTHERN KENTUCKY WATER DISTRICT

FORT THOMAS, KENTUCKY



4-4-06



4/27/06



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Part 1 General

1.01 Scope

- A. The scope of this section is the design and construction of all components and systems necessary for a completely functional and operational Powdered Activated Charcoal (PAC) Building. Where applicable, the balance of the technical specifications for the Project shall be used for this work.
- B. The scope of this Section is associated with Alternate No. 1.

1.02 Special Scope and Performance Requirements

- A. The following paragraphs include many but not all of the required features of the PAC Building. See the Drawings and Specifications for other requirements.
 - 1. General
 - a. Provide preliminary submittal of design showing the complete scope of work and a final submittal, which shall be the construction documents. Submittals shall be prepared by design professionals registered in the state of Kentucky.
 - b. Apply for any permits that are required for this portion of the Work.
 - c. Design the PAC Building to meet the requirements for an H-3 (High Hazard) Use Group. The powdered charcoal dust is combustible. The systems of the building must be explosion-proof.
 - 2. Sitework
 - a. Provide all necessary excavation and backfill. Grade the site of the PAC Building to provide a 1:20 slope away from the building for a distance of 10 feet.
 - b. Compact the subgrade of the drive and floor slab to 98% Standard Proctor.
 - c. Provide a perforated drain inside the foundation walls and extended through the wall to daylight with a concrete "headwall" collar to prevent damage from mowers.
 - d. Provide a heavy duty asphaltic concrete drive to the PAC Building.
 - e. Repair and restore all disturbed areas to new condition.
 - 3. Concrete
 - a. Provide a concrete foundation system for the PAC Building.

- b. Provide a reinforced 5" concrete slab on grade over a vapor retarder and 4" gravel base.
 - c. Finish, cure and seal all concrete.
- 4. Masonry
 - a. Provide a 4' high knee wall exposed to the interior and constructed of 8" concrete masonry units.
- 5. Steel - none
- 6. Wood - none
- 7. Thermal and Moisture Protection
 - a. Provide sealants at all changes in materials.
- 8. Doors and Windows
 - a. Insulate and weatherstrip all doors.
 - b. Provide hardware matching the Chemical Building in quality, design and manufacture. The pedestrian door on the front of the building will receive an access control lock provided by the Owner. The rear door requires a passage latchset with no hardware on the exterior except a security plate over the latch area. Provide a closer for the front door. Provide non-removable pins for all doors.
- 9. Finishes
 - a. Paint all interior and exterior bare or primed metal to match the Chemical Building.
 - b. Paint exposed masonry.
 - c. Paint entire exposed metal structure if dirty or damaged from erection. If acceptable in appearance, touch-up paint abraded areas only.
- 10. Specialties
 - a. Provide sign identifying building with 4" high letters – "PAC BUILDING"
- 11. Equipment
 - a. Provide the material handling equipment shown on the M-series of drawings and specified.

-
12. Furnishings - none
 13. Special Construction
 - a. See paragraph 1.01 Scope.
 14. Conveyances - none
 15. Mechanical
 - a. Plumbing and Fire Protection
 1. Provide 1" water line inside the building.
 2. Provide ¾" hose bibb.
 3. Provide automatic sprinkler system suitable for High Hazard Use Group. The sprinkler system shall comply with applicable codes and Specification 15301 herein.
 4. Provide back flow prevention device.
 - b. HVAC
 1. Provide a heating system designed to maintain 60F degrees inside when 0F degrees outside.
 2. Provide an automatic ventilation system to maintain an indoor temperature in summer that is no higher than 10F degrees above outdoors temperature. Provide a Hand-Off-Auto (HOA) switch in the ventilation system to facilitate manual override.
 3. Note explosion-proof requirements.
 16. Electrical
 - a. Note explosion-proof requirement.
 - b. Provide a main electrical service panel sized for twice the calculated load.
 - c. Provide 25% or five spare breaker spaces, whichever is more.
 - d. Provide spare conduits as shown on the Drawings. Terminate conduits two feet above the floor with a cap.
 - e. Provide light switch and convenience outlets as shown.
 - f. Provide lighting that will achieve 50fc level of illumination throughout the building measured 3' above the floor.
-

- g. Provide one exterior light fixture matching others on the campus. Control the exterior light with a photoelectric cell (ON) and a time clock (OFF).

17. Communications

- a. Provide access control wiring to front door.
- b. Provide communications devices and wiring as shown on the drawings.
- c. Provide spare conduits as shown on the Drawings.

1.03 Referenced Publications

- A. The latest edition of the publications listed below form a part of these Specifications.

1. American Institute of Steel Construction (AISC)

Manual of Steel Construction (includes "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" and "Structural Joints Using ASTM A 325 or A 490 Bolts").

MB Category, Metal Buildings Systems Certified

2. American Iron and Steel Institute (AISI)

Specification for Design of Cold-Formed Steel Structural Members

3. American Society for Testing and Materials (ASTM)

ASTM A 446 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

ASTM A 463 Specification for Steel Sheet, Cold Rolled, Aluminum-Coated, Type I and Type II (Coating TI-40)

ASTM D 3841 Glass Fiber-Reinforced Polyester Plastic Panels

4. American Welding Society (AWS)

D1.1 Structural Welding Code - Steel

5. Metal Building Manufacturers Association (MBMA)

MBSM Metal Building Systems Manual - Design Practices Manual

1.04 Design Requirements – Pre-Engineered Metal Building

- A. The building is identified as the PAC Building and shall be of the dimensions shown and indicated on the Drawings. Nominal dimensions are followed by a "(+)" designation. Dimensions to be held will be shown without the (+) designation. Column locations shall be as shown on the Drawings.
- B. The building shall have out to out girt dimensions as shown and noted on the Drawings. The eave height shall be determined by the clear inside dimensions shown and/or noted on the Drawings.
- C. All frames shall be of the rigid-frame type with roof slopes as shown on the Drawings. Provide bracing of columns and roof as required by manufacturer's design criteria without affecting openings as shown on the Drawings.
- D. Design loads shall be as shown, indicated and noted on the Drawings.
- E. Design shall be based on elastic behavior.
- F. Roof live loads shall not be reduced to any member.
- G. All rigid frames, bracing and posts shall be fabricated from structural steel shapes and/or plates with 1/4-inch minimum thickness.
- H. Purlins, girts and eave struts, intermediate roof struts and ridge struts shall be fabricated from structural steel shapes or plates with 3/16-inch minimum thickness or cold-formed steel structural members with 18 gauge minimum thickness.
- I. All field connections shall be bolted.
- J. The Contractor shall provide the design of the pre-engineered metal building foundations by a structural engineer registered in the state of Kentucky.

1.05 Submittals

- A. Provide for the design of the "pre-engineered" metal building by a structural engineer registered in the State of Kentucky, who shall also seal and sign the submittals noted below.
- B. Design Certification: Submit to the Engineer certification that the design of the "pre-engineered" metal building for this work is accomplished by the responsible registered structural engineer whose name, seal and signature appears on the certification.
- C. Diagrams showing all the load conditions required by the building code noted on the Drawings and all other loads shown, indicated or noted on the Drawings. These diagrams shall also show all the reactions to the load conditions. The seal and signature of the responsible registered structural engineer shall be applied on these

Pre-Engineered Metal Buildings

diagram sheet(s). These diagrams shall be separate from the calculations required for the analysis and design of the structure(s). Calculations are not required to be submitted to, or reviewed by, the Engineer.

- D. A complete set of erection and detail shop drawings, including, but not limited to, anchor bolt sizes and layout, all framing, all roofing and siding, all doors and windows, all vents and louvers, all downspouts, all flashing and accessories. The submittal shall be made in one complete package prepared by the building manufacturer for the complete pre-engineered building. The seal and signature of the responsible registered structural engineer shall be applied to these drawings.
- E. Samples: Submit the manufacturer's standard color samples intended for use on this work.
- F. Certificates of Compliance: Attesting that all materials comply with the requirements of these Specifications.
- G. The Engineer will review, comment and return to the Contractor the required number of marked copies of all items under paragraphs B, C, D, E and F. For paragraph D., the Engineer will not comment on erection procedures and does not require their submittal. The Engineer's review and comments for paragraph D. will be for layout and clearances only and will not relieve the Contractor of the responsibility of providing a design and product that meets all the requirements of these Specifications.
- H. Products for use on this work shall not be fabricated until all the required submittals have been made, reviewed by, and stamped by the Engineer with the notation "NO EXCEPTIONS TAKEN".

1.06 Delivery and Storage

Deliver, store and handle all building components so that they remain dry and undamaged.

1.07 Warranty

Wall and roof panel finishes shall be warranted against chipping, cracking, blistering or peeling, excessive fading or chalking for a period of not less than 20 years. Copies of the warranty shall be submitted to the Engineer for review. Final copies shall be given to the Owner at the time of acceptance of the building. Warranties shall be subject to the approval of the Engineer.

Part 2 Products

2.01 Acceptable Manufacturers

Pre-engineered metal building shall be manufactured by American Building Company, Butler Manufacturing Company, or A & S Building Systems, Inc.

2.02 Materials and Construction

- A. All materials shall be completely fabricated and prepared for shipment, including any necessary crating or handling provisions. All parts of the building are to be accurately made so that in erection all parts will easily fit together. All cutting, punching and forming shall be performed at the factory. All parts shall be marked and referenced on erection drawings and instructions.
- B. Primary Framing
1. The rigid frames shall have straight or tapered columns and roof beams of continuously shop-welded steel sections. Structural steel shapes may be used in conjunction with built-up members when making up the rigid frames. Frame members shall be provided with necessary shop fabricated splice plates, complete with connection bolt holes, for field bolted assembly.
 2. End frames shall be the same as the intermediate frames with provisions for connections to girt posts and girts.
 3. Exterior wall bracing and girt posts at end bays shall be fabricated from structural steel shapes.
- C. Secondary Framing
1. Purlins, girts, eave struts and ridge struts may be fabricated from structural steel shapes or cold formed structural steel members.
 2. "Sag rods" may be structural steel rounds or cold formed structural steel members.
 3. The base angle shall be fabricated from structural steel shapes or cold formed steel members, bolted to the foundation over a grout bed to provide a weathertight joint and neat appearance.
- D. Connections
1. All field connections shall be bolted.
 2. Anchor bolts shall be set according to the dimensions and locations as specified by the building manufacturer.
 3. All bolts connecting primary members together shall be ASTM A 325.
 4. All other bolts may be ASTM A 325 or the manufacturer's standard.

E. Exterior Wall Panel

1. Exterior wall panels shall be no less than 24 gauge with concealed fasteners. The panel system shall be watertight.
2. Panels shall be one-piece from base to top of wall. The wall panels shall be attached to framing with interlocking ribs toward the interior to eliminate fasteners exposed to the exterior.
3. The manufacturer shall form the panels on a continuous rolling mill. Panels shall be factory coated aluminized or galvanized steel, painted and oven baked.
4. Provide sealants where necessary to ensure watertightness.
5. Provide explosion-relief wall panels as required.

F. Exterior Roof Panel

1. Exterior roof panels shall be smooth surfaced, 24 gauge minimum thickness, 16 to 24-inches wide with interlocking, standing seam with double-lock seam ribs. The roof shall be attached to structural members with clips to accommodate all thermal expansion. Roof panels shall be in one piece from eave to ridge line. Fasteners shall be concealed from the exterior.
2. Install panels with ribs parallel to the roof slope. Provide continuous, factory applied sealants at each roof seam and where necessary to ensure watertightness.
3. Roof shall be gabled as shown on the Drawings, with roof slope shown.
4. The panel design shall provide for expansion and/or contraction as caused by an ambient temperature range of 0 to 120 degrees F without causing harmful buckling, opening of joints that violate the weathertightness of the structure and other detrimental effects.
5. All flashings, trim and similar items shall be the manufacturer's standard and shall be of the same material and finish as the building panels.
6. The manufacturer shall form the panels on a continuous rolling mill. The panel steel shall be factory coated aluminized or galvanized steel, painted and oven baked.

G. Interior Wall Liner Panel

1. Interior metal wall liner shall be a 26 gauge minimum thickness panel. Panels shall be ribbed.

2. The wall liner shall be compatible with the exterior wall and bracing system. Panel shall extend from the floor to a height of 8' in one piece and include base trim.
3. The manufacturer shall form the panels on a continuous rolling mill. The panel steel shall be factory coated aluminized or galvanized steel, painted and oven baked.

H. Wall and Roof Insulation

1. The walls and underside of the roof shall be insulated to provide an R-value of 19 for roof and 13 for walls.
2. Provide insulation for the wall and roof system. Acceptable materials include reinforced vinyl faced fiberglass blankets. Provide galvanized "chicken wire" over exposed face of roof insulation.

I. Gutter and Downspouts

1. Gutter and accessories shall be fabricated from 26 gauge aluminized or galvanized steel and factory painted. Color and finish shall match siding.
2. Gutter shall be suspended box sections, formed to match the configuration of the gable.
3. Gutter shall be of sufficient cross sectional area to control roof run-off. Design for a rainfall intensity of 5.75 inches per hour.
4. Gutter shall be attached to the roof panel using the manufacturer's standard method.
5. Gutter endlaps and end closures shall be sealed with the manufacturer's standard watertight materials and methods.
6. Downspouts shall have a sufficient cross section to discharge roof run-off at the locations as shown on the Drawings. Color shall match siding.
7. Downspouts shall be the manufacturer's standard, provided that quality, size and spacing provide adequate roof drainage.
8. A 45 degree elbow shall be provided at the base of all downspouts to direct the water flow away from the building.
9. Provide a concrete splash block at each downspout.

J. Heating and Ventilation

1. Framed openings for ventilators and louvers shall be provided as required to provide proper support and provide a weathertight installation. Ventilation fans

are specified in Section 15870. Fans shall be of heavy duty industrial grade construction. Louvers shall be as provided as specified in Section 15940 herein. Note explosion-proof requirements as indicated under Part 1 of this specification.

2. Flashing and all accessories shall be provided to assure a weathertight installation. Color shall match siding.
3. Framed openings shall be trimmed with prefinished metal matching the siding material and color.
4. Heaters shall be provided as specified in Section 15835 herein.

K. Doors and Windows

1. Provide the doors and windows as shown on the Drawings.
2. Doors and windows shall be the building manufacturer's standard. Interior and exterior door panels shall be 18 gauge minimum thickness, galvanized sheet steel.
3. All door and window frames structural steel components shall be factory fabricated.
4. Provisions shall be made for incorporation of an overhead sectional insulated door into the pre-engineered building. Allow sufficient clearance above the door opening for a vertical or high rise track installation. Provide a 20 gauge metal interior face for the door, weatherstripping, lock. Door shall be manually operable with no more than 25 pounds of force..

2.03 Accessories

- A. The building shall be supplied complete with all the required fascia, ridge cover, flashing and other accessories required to provide a complete installation.
- B. Accessories shall be provided to give a weathertight and detailed finish to the building where penetrations through the building occur (i.e., plumbing thru roof, ventilation fans, etc.).
- C. Provide closures where necessary to ensure weathertight construction.

Part 3 Execution

3.01 Installation

- A. The building shall be constructed by a steel erector regularly engaged in the construction of pre-engineered metal buildings. Construct the building in accordance with the manufacturer's shop/erection drawings and the manufacturer's printed instructions.

- B. Keep primary members plumb and stayed in both directions and maintain a safe work place as required by all applicable codes, standards and regulations.
- C. If defects or errors in fabrication or erection of any building component cannot be corrected in a manner acceptable to the Engineer, remove and provide non-defective components.
- D. Field modifications shall not be made unless they are acceptable to the Engineer.

3.02 Painting

Priming and painting of all primary and secondary framing members shall be in accordance with the requirements of Section 09900 of these Specifications. Final finish coat requires field painting with the color matching the color of interior wall panels.

3.03 Inspection and Testing

- A. Provide for inspection of the work by the building manufacturer and a certification by the building manufacturer that the building has been installed according to the manufacturer's standards and specifications.
- B. Provide suitable access to the work for inspection by the Engineer or a testing laboratory of the Engineer's choosing.

END OF SECTION



Part 1 General

1.01 Scope (MP-FERRIC-T-1, 2, 3, 4; MP-FERRIC-DT-1; MP-PACL-T-1, 2; MP-PACL-DT-1; MP-CAUSTIC-T-1, 2; MP-CAUSTIC-DT-1; MP-HYPO-T-1, 2, MP-HYPO-DT-1; MP-FUT-T-1; MP-FILTAID-DT-1; MP-FILTAID-MX-1; MP-CORR-DT-1)

- A. The storage tanks shall be non-pressure, non-vacuum constructed of fiberglass reinforced plastic compatible for storage of chemicals listed in Table 1.
- B. The tanks shall be suitable for all naturally occurring ground conditions to store products which are compatible with the resin system used in the corrosion barrier.
- C. Submit shop drawings on support system for storage tanks and piping meeting the seismic requirements of the 2002 Kentucky Building Code for Seismic Use Group III and Seismic Design Category "C". Shop drawings shall be stamped and signed by a professional engineer registered in the State of Georgia.

1.02 Submittals

Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01340 of these Specifications.

1.03 Physical Properties

- A. The wall thickness of all tanks shall be determined by the temperature, specific gravity, size and capacity required. The minimum wall or head thickness shall be 0.25-inch.
- B. The surface shall have a barcol hardness of at least 90 percent of the resin manufacturer's minimum specified hardness for the cured resin.
- C. Portions of the tanks, such as joints and fittings, may be fabricated by contact or hand lay-up molding.
- D. The finished laminate shall be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, air bubbles, pinholes and pimples.

1.04 Fiberglass Tanks Schedule

Each tank shall be sized and designed to hold a capacity shown in Table 1 of this Section.

1.05 Quality Assurance

- A. The manufacturer shall furnish written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications. This certification shall be furnished after fabrication and prior to shipment.
- B. The tank manufacturer shall provide unit responsibility for all items specified in this Section. Unit responsibility shall require that all items be products of, or warranted by, the tank manufacturer. The tank manufacturer shall be responsible for all coordination between components and provide all submittals, start-up assistance, and certification on the storage tanks as a unit.
- C. The tank manufacturer shall provide a 3-year non-prorated warranty to the Owner. The warranty shall guarantee that the fiberglass tank corrosion barrier will not degrade during the warranty period.

Part 2 Products

2.01 Acceptable Manufacturers

- A. The storage tanks shall be manufactured by Augusta Fiberglass, Justin Tank, Inc., or Tankinetics.

2.02 Resin

A vinylester resin of a premium grade shall be used, and recommended by the tank manufacturer for the intended service from corrosion test data or from the manufacturer's experience with related environments. Vinyl resin is used for the corrosion barrier and the structural layer of the tank. The inside corrosion barrier shall begin with a minimum 2 Nexus® Veils. Post cure shall be incorporated into the construction. Resin shall be Vipel F010, Hextrol 922, or Derakané 411. Resin to be cured as recommended by the resin manufacturer for the specified chemical service.

2.03 Reinforcing and Surface Material

Material shall be commercial grade of fiberglass, as specified in the fabrication section, having a coupling agent which will provide a suitable bond between the fiberglass reinforcement and the resin.

2.04 Fittings

- A. All FRP flanged nozzles up to 8-inches in diameter will be of the conically gusseted design. All other fittings and/or accessories shall be Acceptable Manufacturer's. Contractor shall block out concrete tank pad to accommodate tank projections.

- B. The flange face shall be perpendicular to the axis of the pipe within 1/2 degree and shall be flat to plus or minus 1/16-inch. Flange face drilling shall correspond to ANSI (ASA) standard B16.5 for 150 pound steel flanges in 1 through 24-inch sizes.
- C. Standard orientation will have bolt holes straddling the principal centerline of the vessel.
- D. Standard flanged nozzles are designed for use with full face gaskets. These should be 1/8-inch thick with a 40 to 50 durometer.
- E. All tanks must be positively vented to the atmosphere with the minimum vent size equal to or greater than the largest inlet or outlet nozzle.
- F. Provide stainless steel hold-down lugs for each tank shown. The number and location of the lugs shall be as specified by the tank manufacturer. The lugs shall be capable of withstanding the buoyancy load for an empty tank of the diameter shown with water to the top of the containment basin wall.
- G. Provide fiberglass angle brackets as part of the tank in line with level transmitters from top to bottom of tank for mounting of electrical conduit.
- H. All tanks shall have flat or annular domed tops; where noted tops shall include FRP handrail from either side of the ladder.
- I. Sight Tube Assembly for Storage Tanks:
 - 1. Tubular type PVC with 2-inch flanged connections.
 - 2. Furnish with diaphragm valves, drain cock, Pyrex glass, and stainless steel guard rods.
 - 3. All parts coming in contact with liquid shall be either PVC or glass.
 - 4. Calibrate the tank in 100-gallon increments and paint the calibrations adjacent to the level tube with graduations and boldface figures.
 - 5. Acceptable Manufacturers:
 - 1. Ernst.
 - 2. Clark-Reliance (Jacoby-Tarbox).
- J. Sight Tube Assembly for Day Tanks:
 - 1. Tubular type PVC with 1/2-inch flanged connections.
 - 2. Furnish with diaphragm valves, drain cock, Pyrex glass, and stainless steel guard rods.

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3. All parts coming in contact with liquid shall be either PVC or glass.
 4. Calibrate the tank in 10-gallon increments and paint the calibrations adjacent to the level tube with graduations and boldface figures.
 5. Acceptable Manufacturers:
 - a. Ernst.
 - b. Clark-Reliance (Jacoby-Tarbox).
- K. Flanged top nozzle for level sensor shall be centered one-sixth of the tank diameter from the inside tank wall. No horizontal penetrations shall occur vertically below the flanged top nozzle on the same radial line.

2.05 Accessories

- A. The following accessories shall be provided for (MP-FERRIC-T-1, 2, 3; MP-PALC-T-1, 2; MP-CAUSTIC-T-1, 2; MP-HYPO-T-1, 2):
1. 24-inch flanged top manway with cover spring loaded for emergency pressure rated.
 2. 24-inch flanged side manway with cover, neoprene gasket, zinc plated fasteners.
 3. 2-inch fill nozzle (conically gusseted).
 4. 2-inch outlet nozzle (conically gusseted).
 5. 2-inch drain nozzle (conically gusseted).
 6. 8-inch vent.
 7. 1-inch relief nozzle.
 8. 4-inch overflow nozzle (conically gusseted).
 9. 6-inch flanged top nozzle for level transmitter.
 10. Fiberglass OSHA approved ladder.
 11. Fiberglass OSHA approved handrail – Top.
 12. Hold-down lugs (2000 Standard Building Code and/or Kentucky Building Code, whichever is greatest).
 13. PVC sight tube assembly.

- B. The following accessories shall be provided for Tanks (MP-FERRIC-DT-1; MP-PACL-DT-1; MP-CAUSTIC-DT-1; MP-HYPO-DT-1).
1. 18-inch flanged side manway (conically gusseted).
 2. 2-inch inlet nozzle (conically gusseted).
 3. 2-inch outlet nozzle (conically gusseted).
 4. 6-inch vent.
 5. 2-inch overflow nozzle.
 6. 6-inch flanged top nozzle for level transmitter.
 7. PVC sight tube assembly.
 8. Fiberglass ladder (OSHA approved).
 9. Hold-down lugs.
- C. The following accessories shall be provided for MP-FILTAID-DT-1.
1. FRP flanged lip.
 2. FRP hinged cover with shaft cutout.
 3. Anti-Vortex baffles
 4. 1 ½-inch outlet nozzle (conically gusseted).
- D. The following accessories shall be provided for MP-CORR-DT-1
1. 1-inch inlet nozzle
 2. 1-inch outlet nozzle (conically gusseted)
 3. 2-inch mushroom vent

2.06 Fabrication

- A. Tank wall shall be fabricated by chopped strand spray-up utilizing a programmed carriage dispenser to apply glass and resin to a mechanically controlled, rotating mandrel, or by filament winding, utilizing wrapping multiple continuous strands of fiberglass onto a rotating mandrel or drum.
- B. Resin and glass should be measured to ascertain proper rate and volume of materials applies. The wall laminate will be constructed as follows:

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1. The first layer shall be vinyl ester resin reinforced with a minimum 2 ply Nexus Veil. This resin-rich layer to be a minimum of 20 mils thick.
2. The second layer shall be vinyl ester resin sprayed upon random oriented chopped strand "E" glass fiber reinforcement to be 20 to 30 percent by weight. This resin rich layer to be a minimum of 100 mils thick.
3. The third layer shall be vinyl ester resin applied by filament winding in accordance with ASTM D 3299 or sprayed upon randomly oriented chopped strand "E" glass fiber reinforcement. Thickness to vary with tank size, design temperature. The surface of this layer shall be resin rich.

2.07 Heat Tracing and Insulation

A. Heat Panels (MP-CAUSTIC T-1, 2 only)

1. Provide a minimum of two 500 watt panel heaters to maintain a temperature of 90 degrees F with an ambient temperature of 0 degrees F.
2. Nominal service voltage shall be 120 volts, single phase AC unless noted otherwise.
3. Coordinate circuit sizing with available electrical circuits shown on the Drawings.
4. Provide power connection kits and other accessories required for a complete operating system. Electrical accessories shall be NEMA 4X rated.
5. Provide NEMA 4X thermostat on each heat circuit to sense air temperature and energize heat tracing at setpoint temperature.

B. Insulation (MP-CAUSTIC-T-1, 2)

1. Polyurethane foam, density 2 PFC, K-factor minimum of 0.16 BTU in/hr ft² F, rigid foam with closed cell structure. Compressive strength per ASTM D 1621, 20 pounds/square inch at ten percent deflection.
2. Water absorption shall be per ASTM D 2842.
3. Overcoat/sealer shall be either a FRP skin 1/8-inch thick (minimum) or flexible, 2-ply of polyethylene/Hypalon, 20 mils thick. Overcoat materials shall have good UV and corrosion resistance and be rated Class A flame retardant material per UL 790.
4. Foam shall be applied on tank sides and roof. If factory finished, coating and insulation shall be repaired and field-finished where damaged in transit or erection.

- C. Provide signage or pipe markers cautioning "DO NOT CUT INSULATION – ELECTRIC HEAT TRACING – SHOCK HAZARAD".

2.08 Mixer (MP-FILTAID-MX-1)

1. Mixing Tank (MP-FILTAID-DT-1) shall be used to mix filter aid polymer and shall have a full cover on which shall be installed a slow speed mixer (MP-FILTAID-MX-1). Mixer shall be designed to provide proper mixing at speeds not to exceed 350 RPM.
2. Mixer: The Mixing Tank shall be complete with a ½ HP Mixer. Mixer Impeller speed shall not exceed 350 RPM and the impeller shall be positioned no less than one and one half impeller diameter from the bottom of the tank. The Mixer Assembly shall include an angle riser support, right angle helical gear Reducer, and TEFC Motor. The Impeller and Shaft shall be 316 stainless steel. The unit shall be designed for heavy duty operation at varying tank levels. The shaft diameter shall be 7/8 inch diameter minimum throughout its entire length.
3. Motor: The motor shall be designed and manufactured in accordance with the standards of NEMA and as specified in Section 16150 of these Specifications and shall have the following characteristics:
 - Horsepower: 0.5
 - Enclosure: TEFC
 - Service Factor: 1.15
 - Power Supply: 120 volts, 60 Hz, 1-phase
 - Insulation: Class F
4. The mixer shall be supported on non-corrosive channels attached to the top of the tank.
5. Four interior full-length FRP vertical baffles shall be provided to facilitate mixing of the tank contents.

2.09 Drum Pump

- A. A drum pump shall be provided suitable for installation on the Owner furnished 55-gallon drum.
- B. Pump shall be electric powered (120V, 60 Hz), sealless capable of flows up to 64 gpm, pressures up to 36 psi.
- C. Suitable for pumping liquid with viscosity up to 1,500 cps.
- D. Housing shall be PVDF, bearing shall be PTFE.
- E. Pump shall be Lutz Model B36.

2.10 Quality Control

- A. Process and quality control shall be constantly monitored and manufacturer must maintain manufacturing and quality control records for each tank.
- B. The first layer surface shall be clean, smooth and uninterrupted with no cracks, or crazes.
- C. No foreign matter large enough to reach the surface of the first layer is permitted.
- D. The exterior surface of the tank shall exhibit good workmanship; smooth and uniform with no exposed fibers, sharp projections or uncoated sanded areas. The exterior surface shall be properly cured.
- E. Factory tank leakage test reports shall be submitted prior to shipment.
- F. All tanks shall be manufactured per ASTM D-4097 and D 3299.

2.11 Special Fabrication Requirements

- A. Tanks utilized for the storage of sodium hypochlorite shall have the following special provisions:
 - 1. The catalyst system for the entire tank shall be benzoyl peroxide and dimethylaniline (BPO/DMA) in amounts selected by the manufacturer for the particular resin system. Tanks utilizing a different catalyst system for the structural portions of the tank are not acceptable. The ratio of benzoyl peroxide to dimethylaniline shall be within recommended ratios as deemed appropriate by the manufacturer.
 - 2. Double synthetic veils shall be provided on the interior of the tank.
 - 3. A post cure using elevated temperatures shall be provided. Cure time and temperature shall be adjusted to provide the maximum protection for the intended chemical service.

2.12 Ultrasonic Level Transmitter

Each tank shall be fitted with an ultrasonic level transmitter supplied by others.

Part 3 Execution

3.01 Installation

Installation shall be in strict accordance with the respective manufacturer's instructions and recommendations in the locations shown on the Drawings.

3.02 Electrical Work

The Contractor shall furnish and install all electrical work and equipment required for a complete and operable installation as shown on the Drawings and as specified in Division 16 of these Specifications.

3.03 Inspection and Testing

The equipment manufacturer shall provide the Contractor with the services of a factory representative for a period of one, eight-hour day during the installation phase of the equipment to insure the Contractor is knowledgeable of proper installation procedures. Upon completion of installation, the Contractor shall furnish a written certification by the equipment manufacturer that the equipment is installed in accordance with their recommendations and is ready for start-up.

3.04 Cleaning

Prior to acceptance of the work of this Section, thoroughly clean all installed materials, equipment and related areas in accordance with Section 01710 of these Specifications.

TABLE 1
FIBERGLASS TANK SCHEDULE

Tag	Diameter (ft)	Usable Capacity (Gallons)	Contents	Specific Gravity
MP-FERRIC-T-1	10	6,000	31-46% Ferric Sulfate	1.38-1.59
MP-FERRIC-T-2	10	6,000	31-46% Ferric Sulfate	1.38-1.59
MP-FERRIC-T-3	10	6,000	31-46% Ferric Sulfate	1.38-1.59
MP-FERRIC-T-4	10	6,000	31-46% Ferric Sulfate	1.38-1.59
MP-PACL-T-1	10	6,000	50% Hyper + Ion 1750	1.28-1.38
MP-PACL-T-2	10	6,000	50% Hyper + Ion 1750	1.28-1.38
MP-CAUSTIC-T-1	10	6,000	50% Caustic Soda	1.54
MP-CAUSTIC-T-2	10	6,000	50% Caustic Soda	1.54
MP-HYPO-T-1	11	8,000	12.5% Sodium Hypochlorite	1.07-1.26
MP-HYPO-T-2	11	8,000	12.5 % Sodium Hypochlorite	1.07-1.26
MP-FUT-T-1	10	6,000	All chemicals above	1.07-1.59
MP-FERRIC-DT-1	4	775	31-46% Ferric Sulfate	1.38-1.59
MP-PACL-DT-1	3.5	255	50% Hyper + Ion 1750	1.28-1.38
MP-CAUSTIC-DT-1	3.5	255	50% Caustic Soda	1.54
MP-HYPO-DT-1	4	425	12.5% Sodium Hypochlorite	1.07-1.26
MP-FILTAID-DT-1	2	50	Filter aid Polymer	.9-1.3
MP-CORR-DT-1	2	110	Sodium Ortho/Phosphate	1.3-1.4

END OF SECTION

Part 1 General**1.01 Scope**

- A. The work described in this Section and/or indicated on the Drawings shall include, except where otherwise noted, the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all mechanical systems. All mechanical work shall be accomplished by workers skilled in the various trades involved.
- B. Prior to the ordering or purchase of any equipment or materials or the layout or installation of any work, visit and examine the site and shall examine and understand the work shown on the Drawings and described in these Specifications. If any work involves existing equipment, ductwork, piping, buildings, etc., first verify model numbers, electrical characteristics, sizes, dimensions, etc. to be compatible with the work shown on the Drawings.
- C. Throughout the course of the Project, schedule and coordinate work with the Owner and other trades to optimize space utilization and avoid conflict or interference with the work of other trades, structural elements, doors, windows, lights, conduit and other equipment or systems.
- D. Unless otherwise shown on the Electrical Drawings, the mechanical work shall include:
 - 1. The furnishing and installation of all motors in accordance with Section 16150, motor starters, relays and other controls and control wiring necessary for the proper operation of all mechanical equipment. Power wiring to mechanical equipment and a 120 volt source for control power shall be provided as a part of the electrical work.
 - 2. All controls and control wiring shall be provided under this Division and installed according to Division 16 of these Specifications. Where control power is not available in the vicinity of mechanical equipment, a transformer shall be furnished and installed to convert power voltage to control voltage. The transformer may be an integral part of the starter.
 - 3. Magnetic starters or combination starters as shown on the Drawings or specified herein, complete with running indication lights in an approved enclosure, shall be furnished and installed for mechanical equipment automatically started and stopped, or otherwise controlled by thermostats, timers, or other devices. Starters for all manually controlled equipment shall include running indication lights in an approved enclosure. Switches for starters shall be as shown on the Drawings or specified herein. All starters shall comply with the requirements of Division 16.
 - 4. Starters shall be of the reduced voltage part winding type for all equipment with motors 50 HP and larger as shown on the Drawings or specified herein.

5. Disconnect switches shall be provided for mechanical equipment in accordance with the National Electrical Code. Coordinate type (fused or not), fuse ratings, enclosure type and installation with equipment nameplate, NEC, NEMA and Division 16 requirements.
- E. All electrical items provided under Division 15 of these Specifications shall be provided in accordance with applicable sections of Division 16. Enclosures shall be the same NEMA type as specified in Division 16 or on the Electrical Drawings.
- F. Produce complete finished operating systems and provide all incidental items required as part of the work, regardless of whether such item is particularly specified or indicated.

1.02 Qualifications

All materials shall be furnished by manufacturers fully experienced, reputable and qualified in the manufacture of the particular material to be furnished. All material shall be designed, constructed and installed in accordance with standard practices and methods and shall comply with these Specifications as applicable.

1.03 Submittals

- A. Submittals for all mechanical work shall conform to the requirements of Section 01340 of these Specifications.
- B. Drawings and Specifications
 1. The Drawings are diagrammatic and, unless specifically dimensioned, are intended to show only the general arrangement of equipment and accessories, and the general routing of piping, ductwork, etc. The Drawings do not specifically show every fitting, offset, contour, etc. required to accomplish the intended work or to avoid every interference that may be encountered. Arrange all work to fit within the allowed space without modifying any building structure or property, and make readily accessible all equipment and accessories requiring servicing or maintenance.
 2. Should any changes be deemed necessary in items shown on the Drawings, shop drawings, descriptions and the reason for the proposed changes shall be submitted to the Engineer for approval.
 3. Exceptions and inconsistencies in Drawings and Specifications shall be brought to the Engineer's attention before Bids are submitted.
 4. Titles of Sections and Articles in these Specifications are introduced merely for convenience and are not to be construed as complete segregation of tabulation of the various units of material and/or work.

- C. Operating and Maintenance Instructions: Complete, neatly framed instructions for the care and operation of all equipment shall be provided and installed where directed. Instruct the Owner's personnel during the adjustment and testing period in the presence of both the Owner's representative and the Engineer, demonstrate the complete operation of each and every piece of apparatus. In the case of heating and air conditioning equipment, both the heating and cooling functions shall be fully demonstrated at such times as are required. Instructional periods shall be for such lengths of time as may be necessary to thoroughly familiarize operating personnel with the proper care, operation and maintenance of the equipment.
- D. Permits and Inspections
 - 1. Obtain and pay for, as part of the mechanical work, all permits, fees, licenses, taxes, assessments, etc. necessary for performing the work outlined in the Contract Documents.
 - 2. All applicable certificates of inspection shall be delivered to the Owner at the completion of the work.

1.04 Transportation and Delivery

- A. As part of the mechanical work, provide and pay for all transportation, delivery and storage required for all equipment and materials.
- B. The mechanical contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.05 Storage and Protection

- A. Upon receipt of all equipment and materials, they shall be properly stored to protect them from vandalism, theft, the elements and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.
- B. Provide protection covers, skids, plugs or caps to protect equipment and materials stored or otherwise exposed during construction.

1.06 Quality Assurance

- A. The manufacturer shall provide written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.

B. Codes and Standards

1. All mechanical work shall be performed in accordance with all applicable codes, ordinances; rules and regulations of local, state, federal or other authorities having jurisdiction. As a minimum, this shall include:
 - a. 2002 Kentucky State Building Code
 - b. 2000 International Mechanical Code
 - c. 2003 International Energy Conservation Code
 - d. 2003 Kentucky State Plumbing Code
 - e. 2000 International Fire Code
 - f. National Fire Protection Association Codes
 - g. 2002 NFPA 54 National Fuel Gas Code
 - h. Unless otherwise specified on the Drawings, the latest edition of all codes, including state and local amendments or ordinances, shall be followed. Where code or other requirements exceed the provisions shown on the Contract Documents, notify the Engineer. Where provisions of the Contract Documents exceed code or other requirements, the Work shall be performed in accordance with the Contract Documents.
2. All equipment, products and materials used in mechanical work shall be Underwriter's Laboratories listed or labeled as applicable.
3. Schedule all required tests and inspections with a minimum of 72 hours prior notice to the Owner and the Engineer.

- C. Allowable Tolerances: Equipment shall be readily adaptable for installation and operation in the structures shown on the Drawings. No responsibility for alteration of a planned structure to accommodate other types of equipment will be assumed by the Owner. Equipment which requires alteration of the structures will be considered only if the Contractor assumes all responsibility for making and coordinating all necessary alterations. All such alterations shall be made at the Contractor's expense.

Part 2 Products**2.01 Materials and Construction****A. General**

1. All equipment, materials, accessories, etc. used as part of the mechanical work shall be new, of the best grade and quality and of current production, unless

specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the intended use and shall be subject to approval by the Engineer.

2. All equipment, products and materials used in mechanical work shall be Underwriter's Laboratories listed or labeled as applicable.
 3. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage or wear.
 4. Electric motors shall be standard efficiency, drip-proof type unless otherwise specified.
- B. Piping: See appropriate sections of Division 15 for Specifications on various piping systems. See Part 3 of this Section for general stipulations on installation of piping systems.
- C. Valves: See appropriate sections of Division 15 for Specifications and Part 3 of this Section for general stipulations on valve installation.
- D. Unions: Provide and install unions between each item of equipment and the valve controlling and/or the various piping connections to it.
1. Steel Pipe: Unions 2-1/2-inches and smaller shall have ground joints. Unions 3-inches and larger shall have flanged unions.
 2. Copper Pipe: Unions 2-1/2-inches and smaller shall have brass ground joints, copper to copper. Unions 3-inches and larger shall have brass flanged unions, with brass bolts.
 3. PVC Pipe: Unions 2-inches and smaller shall have threaded Buna O-rings. Unions 2-1/2-inches and larger shall be flanged.
- E. Strainers
1. Strainers in water lines shall have cast iron bodies, with standard pattern, stainless steel or monel baskets with standard perforations and shall be equal to Hellan Fluid Strainer, Type D, unless otherwise specified in other sections of Division 15.
 2. All strainers shall be of the same size as the piping in which they are installed. Provide dielectric union, if necessary, to isolate strainer from pipe material.
- F. Equipment Bases: Each piece of equipment which is motor driven shall be furnished with an approved base, which shall be in addition to the foundation. Each base shall be furnished integral with the equipment or apparatus, or shall be furnished as a separate item, designed to accommodate the equipment or apparatus. Submit shop drawings for all foundations and supports for review.

G. Dielectric Isolation

1. Wherever copper, brass or bronze piping systems are connected to steel or iron piping systems, this connection shall be made with dielectric isolators. The dielectric isolators shall be so designed that non-ferrous piping materials shall be isolated by the use of Teflon or nylon isolating materials made up in the form of screwed type unions or insulating gaskets and bolt sleeves and washers for standard flanged connection. All dielectric isolators shall be selected for the pressure of the system involved.
2. Dielectric isolators shall be Watts, Epco, Crane or Maloney.

Part 3 Execution**3.01 Installation****A. General**

1. All equipment, materials, accessories, etc. used as part of the mechanical work shall be installed according to the manufacturer's recommendations and in accordance with the best practice and standards for the work.
2. All work shall be performed by competent personnel satisfactory to the Owner and Engineer. All work requiring particular skill shall be performed by persons that have had special training and past experience in that line of work.

B. Equipment Support

1. Major equipment supports (concrete foundations, framed structural openings, etc.) shall be furnished and installed under other Divisions of the Contract Documents as shown on the Drawings. The mechanical work shall include the furnishing and installation of all miscellaneous equipment supports, housekeeping pads, structural members, rods, clamps and hangers required to provide adequate support of all mechanical equipment.
2. Unless otherwise shown on the Drawings, all mechanical equipment, piping and accessories shall be installed level, square and plumb.
3. All equipment, piping, etc. supported by structural joists shall be supported by the top chord only of such joists. Hangers shall not be attached to the bottom chord of any joists.

C. Pipe and Ductwork Penetrations

1. Sleeves shall be installed in all masonry or concrete walls, floors, roofs, etc. for pipe and ductwork penetrations. Sleeves for pipe shall be standard weight steel pipe. Sleeves for ductwork shall be 20 gauge galvanized steel. Sleeves shall be sized to provide a minimum of 1/4-inch clearance between the sleeve and pipe or duct. For insulated pipes or ducts, the clearance shall be between the

sleeve and the insulation. Each penetration shall be firestopped or otherwise protected by listed materials with a minimum fire rating equivalent to the rating of the structural element where it occurs.

2. As far as possible, all pipe and ductwork penetrations shall be provided for at the time of masonry or concrete construction. Where drilling is required, only core drills shall be used. Star drills shall not be used.
3. All pipes penetrating walls or floors of any construction shall be installed with escutcheon plates on both sides of the penetration securely fastened to the wall or floor. In exposed areas, escutcheon plates shall be chrome-plated. All escutcheons plates shall be sized to completely conceal the penetration. Ductwork penetrating walls or floors of any material shall be installed with closure plates on both sides of the penetration. Penetrations through exterior walls shall be sealed weathertight.
4. All penetrations through fire rated structures shall be firestopped with materials listed for such use and shall equal or exceed the rating of the structure being penetrated.

D. Flashing

1. All piping and ductwork penetrating roofs shall be flashed in an approved manner, shall be watertight and shall conform to the requirements detailed in other sections of these Specifications.
2. Flashing for piping shall be sheet lead of not less than six pounds per square foot, shall have a base not less than two square feet, and shall extend up over and into the open end of the pipe. All flashing shall be properly caulked and sealed.

E. Welding

1. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process.
2. All welding operations shall conform to the latest recommendations of the American Welding Society or to the applicable provisions of the ASME Code for Pressure Piping. Pay for all electrical energy and/or gas used in welding.

F. Equipment Connections

1. Extend waste, water, gas and compressed air lines to the various items of equipment as indicated or required, terminating the lines where and as directed. Make all final plumbing connections. Provide shut-off valves and unions at each water, gas and air connection to each item of equipment requiring same. Furnish all P-traps for waste connections to this equipment.
2. During the roughing-in phase of the work, extend service lines to the various items of equipment, terminating them at the proper points for connection to

those items of equipment as indicated on the detailed drawings of the equipment and/or as directed. During the time the equipment is being installed or after it is in place, make all final connections thereto.

3. The equipment manufacturer will provide all holes in the tops, racks, splash backs or aprons required and will furnish all sinks, waste tailpieces, supply fittings, cocks, pedestals, etc., required for all water and gas to be mounted on the equipment.
- G. Cutting and Patching: Where cutting or patching becomes necessary to permit the installation of any work or should it become necessary to repair any defects that may appear in patching, the Contractor shall make the necessary repair at no cost to the Owner.
- H. Large Apparatus and Equipment: All large apparatus and equipment which is specified or shown to be furnished or installed under this Contract, and which may be too large to be moved into its final position through the normal building openings planned, shall be placed in its approximate final position before any obstructing structure is installed. All apparatus shall be cribbed up from the floor and cared for as specified under "Storage and Protection" or as directed by the Engineer.
- I. Cross Connection and Interconnections
1. No plumbing fixture, device or piping shall be installed which will provide a cross connection or interconnection between a distributing supply for drinking or domestic purposes and a polluted supply, such as drainage system or a soil or waste pipe which will permit or make possible the backflow of sewage, polluted water or waste into the water supply system.
 2. Verify location of all existing utilities and make all connections to existing facilities as required.
- J. Thermal Expansion of Piping
1. Furnish and install all devices required to permit the expansion and contraction of all work subject to expansion and contraction, particularly in steam, water supply and circulating systems. In these systems employ expansion joints and guides where required or directed by the Engineer. Swing joints, turns, expansion loops or long offsets shall be provided wherever shown on the Drawings or wherever necessary to allow for the expansion of piping within the building. Broken pipes or fittings broken due to rigid connections must be removed and replaced at no cost to the Owner.
 2. Anchor all lines having expansion joints so that expansion and contraction effect is equally distributed. Verify exact locations of anchors and guides with the Engineer prior to making installation. The lines having expansion joints shall be accurately guided on both sides of each joint. These guides shall consist of saddles and "U" clamps where not otherwise indicated and shall be properly arranged and supported. Submit complete details for approval.

3. In installing expansion members, exercise care to preserve proper pitch on lines. Furnish and install all special fittings, connectors, etc., as required.

3.02 Surface Preparation, Shop, and Field Painting

- A. Unless otherwise specified herein or shown on the Drawings, general painting of mechanical equipment shall be in accordance with Section 09900 of these Specifications.
- B. Touch-up painting of mechanical equipment shall be part of the mechanical work. All equipment and materials that are painted or coated by the manufacturer shall be touched-up prior to completion to conceal any and all scratches or other finish irregularities and to maintain the integrity of the paint or coating. All painting and coating shall match the original and shall conform to the requirements detailed in other sections of these Specifications.
- C. All roof-mounted equipment shall be painted with an exterior paint of a type and color as approved by the Owner. The painting shall not impair the performance of the equipment in any manner.

3.03 Inspection and Testing

- A. Testing of Pipelines: Refer to Section 02666 of these Specifications for general requirements.
- B. The mechanical work shall include all materials and labor required to properly test and balance all mechanical systems as required by codes and as described herein.
- C. Concealed, underground and insulated piping shall be tested in place before concealing, burying or covering. Tests shall be conducted in the presence of the Engineer or designated representative. Equipment, materials and instruments required for tests shall be furnished without incurring additions to the Contract. The Contractor shall schedule all required tests and inspections with a minimum of 72 hours prior notice to the Owner and the Engineer.
- D. Unless otherwise specified herein, all mechanical piping shall be tested as required by Code to 1-1/2 times the rated system pressure or 150 psig, whichever is greater. Care shall be taken to isolate all equipment not suitable for this test pressure by installing pipe caps or blank flanges at the equipment connections. All valves and fittings shall be tested under pressure.
- E. Unless more stringent requirements are specified herein, the following procedures shall be used for pressure testing building mechanical piping gravity-drained piping systems. Soil, waste and vent piping shall be tested with water before installing fixtures. Water test shall be applied to the system either in its entirety or in sections. If the test is applied to the entire system, all openings in the piping shall be closed except to highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening except the highest opening of the section under test shall be plugged and each section shall be filled with water

and tested with at least a 10-foot head of water. Each joint or pipe in the building except the uppermost 10 feet of the system shall be submitted to a test with at least a 10 foot head of water. The water shall be kept in the system, or in the portion under test, for at least one hour before the inspection starts; no drop in the water level will be acceptable.

- F. The services of an independent testing and balancing agency shall be used to balance the air and water distribution systems.

3.04 Cleaning

- A. At all times, the premises shall be kept reasonably clean and free of undue amounts of waste, trash and debris by periodic cleaning and removal. After completion, all foreign material, trash and other debris shall be removed from the site.
- B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, ductwork, etc. shall be thoroughly cleaned both inside and out.
- C. All air moving equipment operated during construction shall have filters in place and changed regularly so as to be clean.
- D. After testing and balancing and just prior to Owner review and acceptance, all systems shall be finally cleaned and shall be left ready for use. Air filters shall be new and piping strainers shall be clean.

END OF SECTION

Part 1 General

1.01 Scope

- A. The work covered by this Section includes furnishing all labor, equipment and materials required to furnish, install and test steel pipe, alloy pipe, stainless steel pipe and copper tubing, including all fittings, sleeves, unions and accessories, as specified herein and/or shown on the Drawings.
- B. The Contractor's attention is called to the fact that all steel and alloy piping or copper tubing are not necessarily shown completely on the Drawings, which are more or less schematic. However, the Contractor shall furnish and install all pipe and fittings and do all piping work indicated or required for the proper operation of all equipment and services requiring such piping.
- C. Steel and alloy air piping in sizes 12-inches and larger shall be furnished and installed under Section 15061 of these Specifications.

1.02 General Design Requirements

- A. All such work shall be done by competent workers in a thorough workmanlike manner according to best practice and in compliance with all codes and applicable regulations, with proper provisions for uncoupling, draining, expansion and contraction.
- B. Process piping furnished as an integral part of an item of equipment shall conform to the requirements of the latest edition of ANSI B16.3, Code for Petroleum Refining Piping or ANSI B16.4, Code for Refrigeration Piping, as applicable.

1.03 Submittals

Complete shop drawings and engineering data on fabricated piping shall be submitted to the Engineer in accordance with the requirements of the Section 01340 of these Specifications.

1.04 Storage and Protection

- A. Piping and accessories shall be stored and protected in accordance with the requirements of Section 01640 of these Specifications.
- B. All piping and tubing and accessories shall be stored above ground fully supported so as not to bend or deflect excessively under their own weight. Piping shall be stored with slope so as to be free draining.

1.05 Quality Assurance

Prior to its incorporation into the work, the Contractor shall submit to the Engineer written evidence that the pipe furnished under this Section is in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the pipe supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate ASTM or AWWA testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on samples of pipe materials.

Part 2 Products

2.01 Materials and Construction

A. General

1. Unless otherwise shown or specified on the Drawings, all piping 2-1/2-inches and smaller shall be copper tubing, except that Schedule 40 red brass threaded nipples with 125 pound forged bronze threaded fittings per ANSI B16.15 are acceptable for short branches to pressure gauges and drains. Unless otherwise shown or specified, pipe 3-inches and larger shall be galvanized alloy pipe or cast iron or ductile iron pipe. Carbon steel pipe shall be used only where approved by the Engineer or where specifically indicated on the Drawings.
2. No broken, cracked, deformed, imperfectly coated or otherwise damaged or defective pipe or fittings shall be used. All such materials shall be removed from the site.

B. Alloy Pipe

1. Alloy pipe shall be nickel-copper alloy steel pipe conforming to the requirements of ASTM A 714, Grade IV or V, Class 4. Alloy pipe in sizes 2-inches and larger shall be seamless.
2. Alloy pipe 6-inches and smaller shall be screwed, Schedule 40. Alloy pipe for process piping in sizes 3 through 6-inches shall be welded, Schedule 40. Alloy pipe in sizes 8 through 14-inches shall be welded, Schedule 20 exposed, Schedule 40 buried.
3. Screwed fittings shall be of 150 pound malleable iron conforming to ASTM A 197 and ANSI B16.3 or 3,000 pound forged nickel-copper alloy steel conforming to ANSI B16.11. Unions shall be 300 pound malleable iron.
4. Welded fittings shall be wrought nickel-copper alloy steel of the same composition as the pipe and shall conform to ANSI B16.9.

5. Unless otherwise shown or specified, alloy pipe and fittings shall be hot-dip galvanized in accordance with the requirements of ASTM A 153. Exposed alloy piping shall be field primed and painted after installation in accordance with the requirements of Section 09900 of these Specifications.

C. Steel Pipe

1. Steel pipe in sizes 2-1/2-inches and smaller shall be seamless carbon steel pipe conforming to the requirements of ASTM A 53. Steel pipe in sizes 3 through 10-inches shall be seamless carbon steel pipe conforming to the requirements of ASTM A 53, Grade B.
2. Unless otherwise specified or shown, steel pipe 6-inches and smaller shall be welded, Schedule 40. Steel pipe in sizes 8 through 10-inches shall be welded, Schedule 20 exposed, Schedule 40 buried.
3. Screwed fittings 2-1/2-inches and smaller shall be 150 pound malleable iron conforming to ASTM A 197 and ANSI B16.3. Unions shall be 300 pound malleable iron.
4. Welded fittings shall be of the butt-welded type of wrought carbon steel conforming to ASTM A 234, Grade WPB and ANSI B16.9. Reducing branch connections shall be made using threadolets or weldolets.
5. Flanges shall be 150 pound, forged steel conforming to ASTM A 181, Grade I, and ANSI B16.5. Bolts shall be ASTM A 307, Grade B, cadmium plated. Nuts shall be heavy hex nuts conforming to ASTM A 307, Grade B, cadmium plated. Gaskets shall be of red rubber, 1/16-inch thick, conforming to ANSI B16.21. Gaskets for piping operating at temperatures in excess of 150 degrees F shall be compressed asbestos or soft corrugated metal.
6. Unless otherwise shown or specified, steel pipe and fittings 6-inches and smaller in size shall be hot dip galvanized in accordance with the requirements of ASTM A 153. Exposed steel piping shall be field primed and painted in accordance with the requirements of Section 09900 of these Specifications.

D. Stainless Steel Pipe

1. Stainless steel pipe in sizes 10-inches and smaller shall be seamless stainless steel pipe conforming to the requirements of ASTM A 312, Type 304.
2. Unless otherwise specified or shown, stainless steel pipe 1-1/2-inches and smaller shall be screwed, Schedule 40S. Steel pipe in sizes 2 through 10-inches shall be welded, Schedule 10S.
3. Screwed fittings and unions 1-1/2-inches and smaller shall be 3,000 pound forged stainless steel conforming to ASTM A 182, Grade F304 and ANSI B16.11.

4. Welded fittings shall be of the butt-welded type of wrought stainless steel conforming to ASTM A 403, Grade WP304 and ANSI B16.9. Reducing branch connections shall be made using threadolets or weldolets.
5. Flanges shall be 150 pound, forged stainless steel conforming to ASTM A 182, Grade 304 and ANSI B16.5. Bolts shall be heavy hex conforming to ASTM A 193, Grade B8. Nuts shall be heavy hex conforming to ASTM A 194, Grade 8. Gaskets shall be red rubber, 1/16-inch thick, conforming to ANSI B16.21. Gaskets for piping operating at temperatures in excess of 150 degrees F shall be compressed asbestos or soft corrugated metal.

E. Copper Tubing

1. Exposed copper tubing for water or gas shall be seamless harddrawn copper tube conforming to the requirements of ASTM B 88, Type L. Buried copper tubing shall be seamless, annealed copper tube conforming to the requirements of ASTM B 88, Type K. Annealed copper tube may be furnished in straight lengths or coils.
2. Copper tubing for instrument air service in sizes 5/8-inch O.D. and smaller shall be coated, seamless, bright annealed copper tube conforming to ASTM B 68, Type DHP. Wall thickness of copper tube shall be as follows:

Tube O.D.	Wall Thickness
1/4"	0.030"
3/8"	0.032"
1/2"	0.035"
5/8"	0.040"

3. Instrument air tubing shall be factory coated with a layer of black PVC meeting the requirements of ASTM D 1047, IPCEA S-61-402, and applicable UL standards. Minimum coating thickness shall be 0.032-inch. Unless otherwise shown, minimum size of instrument air tubing shall be 3/8-inch O.D.
4. Fittings for copper tube shall be wrought copper conforming to ASTM B 75 and ANSI B16.22 for silver brazed joints. Fittings for annealed copper tube in instrument air service shall be of the flareless, compression type, Hoke "Gyrolok", Crawford "Swagelok" or Parker "Trible-Lok", conforming to ASTM B 16 or B 124.

F. Stainless Steel Tubing

1. Stainless steel tubing for sample and process leads shall be seamless, bright annealed stainless steel tube conforming to ASTM A 269, Type 316 with minimum 3/8-inch O.D. and 0.035-inch wall thickness.

2. Fittings for stainless steel tubing shall be of the flareless, compression type of 316 stainless steel.
 3. Where process leads or sample tubing are specified to be heat traced, furnish pre-insulated factory traced and jacketed tubing with 4 watts per foot, parallel, self-regulating, electric tracing, glass fiber, insulation and black, 105 degree PVC jacket overall. Tubing shall conform to Article 2.06, paragraph A. above. Product shall be factory mutual approved for Class I, Division 2 locations and shall operate on 120 volt, 60 Hz, single phase power. All necessary termination and splicing accessories shall be furnished by the tubing manufacturer.
- G. Unions: Unions shall be of the ground joint type. Unions in carbon steel and alloy steel piping shall be 300 pound galvanized malleable iron conforming to ASTM A 197 and ANSI B16.3 with bronze to iron seats. Unions in stainless steel piping shall be 3,000 pound forged stainless steel conforming to ASTM A 182, Grade F304 and ANSI B 16.11. Unions in copper piping shall be cast red bronze with bronze to bronze seats.
- H. Pipe Dope
1. All threaded connections shall be made up using teflon pipe dope applied to the male threads only.
 2. Virgin Teflon thread tape shall be Hercules Packing Company "Herculon", 3-M Company "Scotch No. 48" or Crane Packing Company "Teflon Thread Tape".
 3. Teflon thread paste may be used in place of tape on very large or very small joints.
- I. Expansion Couplings
1. Expansion couplings for steel and alloy pipe shall conform to the requirements of Section 15095 of these Specifications.
 2. Expansion couplings shall be furnished where shown on the Drawings, required, or directed by the Engineer.
- J. Linings
1. Where shown or specified, piping shall be furnished with a coal tar enamel lining or coal tar epoxy lining as described herein.
 2. Coal tar enamel linings shall consist of a primer and a hot-applied lining of coal tar enamel. Pipe to be coated shall be given a solvent cleaning followed by a commercial blast cleaning in accordance with SSPC SP-6. Primer shall be applied immediately after blasting. Thickness of coal tar enamel lining shall be 3/32-inch. Except for specials and welded field joints, all pipe shall be lined in the shop by mechanical means. Coal tar enamel lining shall conform to the requirements of AWWA C203.

Steel and Alloy Piping and Copper Tubing

3. Coal tar epoxy linings shall consist of a two-component inhibitive epoxy primer and a two-component high build, polyamide cured coal tar epoxy lining. Pipe to be coated shall be given a solvent cleaning followed by a near white blast cleaning in accordance with SSPC SP-10. Primer shall be applied immediately after blasting to a minimum dry film thickness of 1.5 mils. Coal tar epoxy finish shall be applied in two coats having a minimum dry film thickness of 10 mils per coat. Finished lining shall have a dry film thickness of 20-25 mils. Except for specials and welded field joints, all pipe shall be lined in the shop by mechanized means. Coal tar epoxy linings shall conform to the requirements of AWWA C210.
4. The manufacturers of the lined pipe and field lining materials shall furnish the Engineer written certifications that the pipe lining systems conform to all applicable requirements of AWWA C203 or AWWA C210, as appropriate.

K. Coatings

1. Where shown or specified, buried piping shall be furnished with a coal tar enamel coating or cold-applied, plastic tape wrap coating as described herein.
2. Coal tar enamel coatings shall consist of a primer, a hot-applied coating of coal tar enamel, a bonded wrap of coal tar saturated asbestos felt, and a protective wrapping of 75 pound Kraft paper. Pipe to be coated shall be given a solvent cleaning followed by a commercial blast cleaning in accordance with SSPC SP-6. Primer shall be applied immediately after blasting. Except for specials, fittings and field joints, all pipe shall be coated in the shop by mechanical means. Coal tar enamel coatings shall conform to the requirements of AWWA C203.
3. Cold-applied, plastic tape wrap coatings shall consist of a primer, a cold-applied wrap of laminated polyethylene tape, and a protective wrapping of 90 pound Kraft paper or 50-50-50 pound laminated Kraft paper. Pipe to be coated shall be given a solvent cleaning followed by a commercial blast cleaning in accordance with SSPC SP-6. Primer shall be applied immediately after blasting. Laminated tape wrap shall have an overall thickness of not less than 1/2-inch. Except for specials, fittings and field joints, all pipe shall be coated in the shop by mechanical means. Cold-applied plastic tape wrap coatings shall comply with the requirements of AWWA C209 and C214. Plastic tape coatings and materials shall be as manufactured by the Tapecoat Company, Republic Steel Corporation or Polyken Division of Kendall Company, subject, however, to the requirements of these Specifications.
4. The manufacturers of the coated pipe and field coating materials shall provide the Engineer with written certifications that the pipe coating systems conform to all applicable requirements of AWWA C203, C209, C210 or C214, as appropriate.

Part 3 Execution

3.01 Installation

A. General

1. All exposed piping shall be firmly anchored and supported by pipe supports or anchors as shown or required. Pipe supports shall be furnished as shown on the Drawings or in accordance with the requirements of Section 15094 of these Specifications. All pipe shall be carefully placed to the proper lines and grades as shown on the Drawings.
2. Full lengths of pipe shall be used wherever possible. Short lengths of pipe with couplings will not be permitted. Pipe shall be cut to exact measurement and shall be installed without forcing or springing.
3. Lines which slope shall have the right-of-way over lines whose elevations can be changed. Offsets, transitions, and changes in direction in pipes shall be made as required to maintain proper head room, slope, etc.
4. Piping shall be installed in such manner and at such times as will require a minimum of cutting and repairing of building structures. In case any such cutting or repairing is necessary, it shall be done only with the permission of the Engineer. Cutting and repairing shall be performed by craftsmen of the trade which originally executed the work, and repairs shall match the original condition.
5. Except for annealed tubing, all changes in direction in piping systems shall be made with suitable fittings. Annealed tubing shall be bent using suitable bending tools.
6. When storing and installing pipe, care shall be taken to prevent damage to the pipe coatings. Steel pipe with an exterior bituminous or plastic coating or wrapping shall be handled using rubber or canvas slings. All damaged coatings shall be repaired to the satisfaction of the Engineer.
7. A liberal number of unions and/or flanged joints shall be used to permit the ready removal of any section. Unions shall be installed in all piping connections to equipment, to regulating valves, and wherever necessary to facilitate the dismantling of piping and removal of valves and other items requiring maintenance. Flanges on equipment may be considered as unions.
8. Installed piping shall not interfere with the operation of or accessibility to doors and/or windows, shall not encroach on aisles, passageways and equipment, and shall not interfere with the servicing or maintenance of any equipment.

9. The interior of all piping shall be free from obstructions and protrusions. All burrs shall be removed from the inside and outside edges of all cut pipe by reaming. Cutting shall be done in such a manner so as to leave a smooth end at right angles to pipe threads. Tool marks and unnecessary pipe threads shall be avoided. Cuttings and other foreign material shall be removed from the inside of the pipe prior to installation.
10. Unless otherwise shown on the Drawings, piping and tubing laid underground shall have a minimum cover over the top of the pipe as follows:
 - a. Located in Roadway: 48-inches
 - b. Located in Other Paved Areas: 36-inches
 - c. Water, Gas and Drain Piping, 4-inch I.D. and Larger: 30-inches
 - d. Water, Gas and Drain Piping, 3-1/2-inch I.D. and Smaller: 24-inches
 - e. Located Under Building: 6-inches
11. Suitable galvanized steel pipe sleeves of adequate inside diameter shall be provided where piping or tubing passes through walls and floors of buildings and structures. Inside diameter of sleeve shall be approximately 1/2-inch larger than outside diameter of pipe or insulation. A welded steel plate waterstop with a minimum dimension 4-inches larger than outside diameter of sleeve shall be furnished for use in underground walls. Sleeves shall be built into the concrete or masonry wall or floor. Under no circumstances will blocking out or breaking of walls be permitted for later insertion. After installation of piping, the space between the pipe and the sleeve shall be caulked air and watertight. Caulking shall be oakum and lead in concrete and masonry construction and rope asbestos in wood or plaster construction.
12. After installation, the interior of all piping shall be cleaned as necessary to remove flux, slag, scale, rust, dirt, oil, and other foreign material. As piping is installed, open ends shall be covered or plugged as necessary to prevent the entrance of foreign matter and to maintain the required cleanliness.
13. Piping laid underground shall be fully supported along its entire length by a compacted layer of select earth backfill or sand in accordance with the requirements of Section 02200 of these Specifications. Select earth backfill (or sand, in the case of coated or wrapped steel pipe) shall also be placed and compacted around the piping to provide a cover of not less than 12-inches over the top of the pipe.
14. Piping and tubing shall be supported as shown on the Drawings and/or specified in Section 15094 of these Specifications.

15. Changes in pipe size shall be made using reducing fittings, not bushings. If centerline elevation is not specified, use eccentric reducers in horizontal piping. On liquid lines, eccentricity shall be down with top of pipe level. On vapor and gas lines, eccentricity shall be up with bottom level.
16. Indicated locations and sizes of equipment connections are approximate; exact locations and sizes of piping, valves, etc., shall conform to approved shop drawings. Connection sizes shall not be smaller than scheduled size or equipment outlet size, whichever is larger.

B. Installation of Steel and Alloy Piping

1. Pipe threads shall be concentric with the outside of the pipe and shall conform to ANSI B2.1. When threading stainless steel pipe, dies shall have 20 to 30 degree hook. Finished joints shall have no more than three threads exposed. Before assembly, pipe ends and threads shall be inspected and any defective pieces replaced. All joints shall be properly aligned before connection to prevent thread damage. Pipe dope shall be used on the male threads of all threaded connections. Teflon thread tape shall be applied two threads back from the end of the pipe of fitting to prevent shredding. Excess pipe dope shall be trimmed or cleaned off to provide adherence for paints or coatings. After joining, exposed threads in underground piping shall be given a heavy coat of bituminous paint or other suitable protective compound prior to backfilling.
2. All flanges shall be faced and drilled and shall be true and perpendicular to the axis of the pipe. Flanges shall be cleaned of all burrs, deformations or other imperfections before joining. Flanged joints shall be installed so as to ensure uniform gasket compression. All bolting shall be pulled up to the specified torque by crossover sequence. Where screwed flanges are used, the pipe edge shall not extend beyond the face of the flange, and the flange neck shall completely cover the threaded portion of the pipe. Where slip-on flanges are used, the distance from the end of the pipe to the gasket face of the flange shall not exceed "t" plus 1/4-inch, where "t" is the pipe wall thickness. Unless otherwise required, bolt holes shall straddle the vertical and horizontal axes of the pipe. Connections to equipment shall be made in such a way that no strain is placed on the equipment flanges.
3. For flanged connections between steel or alloy piping and cast or ductile iron piping or valves, steel flanges shall be flat faced and furnished with full-face gaskets, insulating bushings, and, when buried, stainless steel bolts.
4. Where steel or alloy pipe is connected to copper tubing, insulating bushings or couplings shall be used to prevent galvanic corrosion.

C. Installation of Copper Tubing

1. Annealed copper tubing shall be cut square, and ends reamed using suitable tools. Bending tools shall be used in making bends. Minimum bend radii shall be 1-inch for 1/4-inch O.D. tubing and 1-1/2-inches for 3/8-inch O.D. and larger.

Compression fittings shall be installed in conformance with the manufacturer's instructions. Plastic coatings shall be cut back only far enough to permit installation of fittings. When a section of tubing is cut from a coil, the end of the unused portion shall be crimped closed.

2. Hard drawn copper tubing and fittings shall be assembled using silver brazing alloy and flux as recommended by the manufacturers. Tubing shall be properly cut square, ends reamed, and both fitting and tubing polished with steel wool before fluxing. Joints shall be properly heated, care being taken not to overheat. After the brazing alloy has been run in, the joint shall be wiped clean. Brazing wire shall be fluxed before using. Unless otherwise specified, copper tubing shall be installed in conformance with the manufacturer's instructions.

3.02 Surface Preparation and Shop Painting

All ferrous piping not specified to be galvanized or otherwise coated shall be cleaned and shop primed or coated in accordance with the requirements of Section 01640 of these Specifications.

3.03 Field Painting

Following installation and testing, all exposed piping shall be field primed and painted in accordance with the requirements of Section 09900 of these Specifications.

3.04 Inspection and Testing

- A. After all piping has been placed and backfilled between the joints, each run of newly laid pipe, or any valved section thereof, shall be tested by the Contractor in the presence of the Engineer, and tests shall be continued until all leaks have been made tight to the satisfaction of the Engineer.
- B. All piping carrying liquids under pressure shall be subjected to a hydrostatic gauge pressure of 150 percent of the maximum expected operating pressure or 150 psig, whichever is greater, based on the elevation of the lowest point of the section under test, corrected to the elevation of the pressure gauge. All piping carrying low pressure air shall be subjected to a hydrostatic gauge pressure of at least 150 percent of the maximum expected operating pressure or 15 psig, whichever is greater.
- C. All testing shall be in accordance with the procedures outlined in Section 01666 of these Specifications.
- D. The Contractor shall take all precautions necessary to protect any equipment that might be damaged by the pressures used in the tests. Delicate equipment shall be valved off, removed or otherwise protected.
- E. All piping shall be securely anchored and restrained against movement prior to application of test procedures. Prior to the pressure test, pipe laid in trenches shall be

partially backfilled adequately to secure the pipe during the test. All joints, fittings and valves will be left open where possible. All exposed pipe, fittings, valves and joints shall be carefully examined during the pressure test.

- F. Before applying the specified test pressure during a test using water as the pressurizing medium, all air shall be expelled from the pipe. If hydrants, blowoffs, or air release valves are not available at the high places, the Contractor shall make the necessary taps at points of highest elevation before the test is made and insert plugs after the test has been completed.
- G. Subject welded joints to hammer tests while under pressure.
- H. Any leakage developing during the test shall be corrected at the Contractor's expense by tightening, replacing packing or gaskets, or replacing defective portions of the piping system. No caulking will be permitted. If the defective portion cannot be located, the Contractor, at Contractor's expense, shall remove and reconstruct as much of the original work as necessary to obtain a piping system tested without leakage.
- I. After all tests on any section have been completed to the satisfaction of the Engineer, the Contractor shall carefully clean, blow out, and drain the line of all water to prevent freezing of the same. The Contractor shall also demonstrate to the satisfaction of the Engineer that any and all lines are free from obstructions and foreign material.
- J. The Contractor shall bear the complete cost of the tests, including set up, labor, temporary piping, blocking, gauges, bulkheads, water, air, soap solutions, and other materials required to conduct the tests.

3.05 Disinfection

Following installation and testing, potable water lines shall be disinfected in accordance with the requirements of Section 02675 of these Specifications.

END OF SECTION

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Ductile Iron Piping and Ductile Iron and Cast Iron Pipe Fittings

Part 1 General

1.01 Scope

The work covered by this Section includes furnishing all labor, equipment and materials required to furnish, install and test ductile iron piping, including all ductile iron fittings, wall pipe and sleeves, couplings, toppings, anchor blocks and accessories, as specified herein and/or shown on the Drawings.

1.02 Submittals

- A. Complete shop drawings and engineering data on all piping and accessories shall be submitted to the Engineer in accordance with the requirements of Section 01340 of these Specifications.
- B. Shop drawings shall indicate piping layout in plan and/or elevations as may be required and shall include a complete schedule of all pipe, fittings, specials, hangers and supports. Special coatings shall be clearly detailed showing all pertinent dimensions.
- C. The Contractor shall furnish the Inspector with lists of all pieces of pipe and fittings in each shipment received. These lists shall give the serial or mark number, weight, class, size and description of each item received.

1.03 Storage and Protection

- A. Piping and accessories shall be stored and protected in accordance with the requirements of Section 01640 of these Specifications.
- B. All piping and accessories shall be stored above ground and at a slope so as to be free-draining.

1.04 Quality Assurance

- A. The Contractor shall submit written evidence to the Engineer that the pipe furnished under this Specification is in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the pipe supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate ASTM or AWWA testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on samples of pipe materials.
- B. Each ductile iron pipe length and fitting shall be clearly marked with the pressure rating, metal thickness class, heat mark, net weight (excluding lining or coating) and name of the manufacturer.

Part 2 Products

2.01 Ductile Iron Pipe

- A. Ductile iron pipe shall be utilized for all piping.
- B. Ductile iron pipe shall be manufactured in accordance with AWWA C151. All pipe, except specials, shall be furnished in nominal lengths of 18 to 20 feet. Sizes will be as shown on the Drawings. All pipe shall have a minimum pressure rating as indicated in the following table, and corresponding minimum wall thickness, unless otherwise specified or shown on the Drawings:

Pipe Sizes (inches)	Pressure Class (psi)
4 - 12	350
14 - 18	350
20	300
24	250
30 - 42	200

- C. Flanged pipe minimum wall thickness shall be equal to Special Class 53. Flanges shall be furnished by the pipe manufacturer.
- D. Restrained joint pipe on supports shall have bolted joints and shall be specifically designed for clear spans of 36 feet, minimum.
- E. Fittings and Accessories
- Fittings shall be ductile iron and shall conform to AWWA C110/ANSI A21.10 with a minimum rated working pressure of 250 psi.
 - Flanged elbow fittings shall be ANSI pattern using short radius elbows except where noted differently on the Drawings. Special fittings, ductile iron wall pipes and sleeves shall conform to the dimensions as shown on the Drawings.
 - Thrust Collars: Thrust collars shall be welded-on ductile iron body type capable of withstanding a thrust due to 250 psi internal pressure on a dead end from either direction on that pipe size. Weld-on collars shall be continuously welded to the pipe by the pipe manufacturer.
 - Welded-on Outlets: Welded-on outlets shall be ductile iron body type and shall be faced and tapped for AWWA C110/ANSI A21.10 flange or mechanical joint connection. All welding, fabrication and outlet hole drilling shall be performed by the manufacturer. Outlets shall be free of burrs. Sizes shall be as indicated on

the Drawings. The outlets shall be welded on minimum Class 51 ductile iron pipe greater than 12-inches and Class 52 for smaller pipe.

5. **Solid Sleeves:** Solid sleeves shall permit the connection of plain end ductile iron pipe. Solid sleeves shall meet the requirements of ANSI/AWWA C110 for pattern and have a minimum pressure rating of 250 psi. Solid sleeves shall have a mechanical or restrained joint as specified in this Section and as shown on the Drawings. Solid sleeves shall be provided with gaskets suitable for the type of pipe to be connected. Solid sleeves shall be used only in locations shown on the Drawings. Solid sleeves shall be manufactured by ACIPCO, U.S. Pipe or McWane (Clow).
- F. **Joints for Ductile Iron Pipe and Fittings**
1. **General**
 - a. Joints for ductile iron pipe and fittings shall be mechanical joint, flanged joint, restrained joint or push-on joint as shown on the Drawings or specified herein.
 - b. Unless otherwise shown on the Drawings, specified or directed, all ductile iron pipe laid underground shall be joined using mechanical joints or push-on type joints.
 - c. In all cases, gaskets shall be made of material that will not be damaged by the fluid being transported nor by the environment in which the pipe is installed.
 - d. Provide the necessary bolts for connections. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A external and 2B internal fit. All bolts and nuts shall be made in the U.S.A.
 2. **Mechanical Joints**
 - a. Joints shall conform to AWWA C111/ANSI A21.11.
 - b. Bolts and nuts shall be Tee Head Bolts and nuts of high strength low-alloy steel in accordance with ASTM A 242 to the dimensions shown in AWWA C111/ANSI A21.11.
 - c. Gaskets shall be in accordance with AWWA C111/ANSI A21.11 and shall be constructed of plain rubber.
 - d. Mechanical joint glands shall be ductile iron.
 3. **Push-On Joints:** Push-on joints and gaskets shall conform to AWWA C111/ANSI A21.11. Details of the joint design shall be in accordance with the manufacturer's standard practice such as ACIPCO "Fastite", McWane (Clow) "Bell-Tite", or U.S. Pipe "Tyton" joints.

4. Flanged Joints

- a. Flanged joints shall conform to AWWA C115/ANSI A21.15. Flanges shall be ductile iron and shall be furnished by the pipe manufacturer.
- b. Gaskets shall be made of 1/8-inch thick, cloth reinforced rubber. Gaskets may be ring type or full face type.
- c. Flanged ductile iron pipe shall have flanges cast solidly or threaded to the pipe barrel. Pipe threads shall be of such length that with flanges screwed home, the end of the pipe shall project beyond the face line of the flange. Flange and pipe shall then be machined to give a flush finish to the pipe and the flange and surface shall be normal to the axis of the pipe. Ductile iron flanges shall be of such design that the flange neck completely covers the threaded portion of the pipe to protect same against corrosion. All pipe with threaded type flanges shall be assembled, faced, and drilled at the point of manufacture, unless otherwise approved by the Engineer.
- d. Flange filler shall conform to AWWA C110/ANSI A21.10. Joint bolt length shall be increased by the thickness of the flange filler.
- e. Where tap or stud bolts are required, flanges shall be drilled and tapped accordingly.
- f. Bolt length and diameter shall conform to ANSI/AWWA C115 for Class 125 flanges shown in ANSI/ASME B16.1.
- g. Bolts for exposed service shall be zinc plated, cold pressed, steel machine bolts conforming to ASTM A 307, Grade B. Nuts for exposed service shall be zinc plated, heavy hex conforming to ASTM A 563. Zinc plating shall conform to ASTM B 633, Type II.
- h. Bolts for submerged service shall be stainless steel machine bolts conforming to ASTM A 193, Grade B8. Nuts shall be heavy hex, stainless steel conforming to ASTM A 194, Grade 8.

5. Restrained Joints

- a. Restrained joints shall be ACIPCO "LOK-FAST" or McWane (Clow) "SUPER-LOCK" or U.S. "TR-FLEX".
- b. Restraining gaskets shall be ACIPCO "Fast-Grip" or U.S. Pipe "Field-Lok Gasket".
- c. Bolts and nuts shall be in accordance with the manufacturer's recommendations.

Ductile Iron Piping and Ductile Iron and Cast Iron Fittings

- d. Gaskets shall be in accordance with the manufacturer's recommendations.
 - e. Joints for restrained joint pipe on supports shall be equal to American "LOK-FAST", U.S. Pipe "LOK-TYTE", or Clow "LONG SPAN".
- G. Cement Linings: Unless shown or specified otherwise, pipe and fittings shall be cement lined in accordance with AWWA C104/ANSI/AWWA C104/A21.4.
- H. Wall Sleeves and Wall Pipes
- 1. Where piping passes through concrete structures, furnish and install wall sleeves unless wall pipes or other provisions are specifically shown on the Drawings. Wall sleeves shall be accurately located and securely fastened into position before concrete is poured.
 - 2. Wall Sleeves
 - a. For pipe sizes smaller than 3-inches, wall sleeves shall be steel oversize sleeves furnished with a full circle, integral, or continuously welded waterstop collar. The sleeve seal shall be the mechanically expanded, synthetic rubber type. Provide all associated bolts, seals and seal fittings, pressure clamps, or plates necessary to achieve a watertight installation. Sleeves shall extend the full thickness of the concrete. Sleeves and seal shall be Link Seal.
 - b. For larger pipe sizes, wall sleeves shall be statically ductile iron mechanical joint wall sleeves. Unless specified or shown otherwise for a specific situation, wall sleeves shall be mechanical joint bell-plain end type with waterstop/thrust collar. The collar shall be capable of withstanding a thrust force caused by a 250 psi dead end load from either direction on that size pipe. Sleeves shall be constructed with studs and mechanical joint [retainer] gland on the air side of the concrete structure. Provide retainer gland where shown on the Drawings. Where the concrete structure is exposed to dirt on one side and is wet on the other side, construct with studs and glands on the dirt side. Wall sleeves shall be equal to ACIPCO A-10771.
 - 3. Wall Pipes
 - a. Wall pipes shall be either statically cast ductile iron with integral waterstop/thrust collar or centrifugally cast ductile iron with a continuously welded waterstop/thrust collar. The welded on collar shall be attached to the pipe by the manufacturer. The collar shall be capable of withstanding a thrust force caused by a 250 psi dead end load from either direction on that size pipe. Wall pipes shall be furnished uncoated on the outside and cement lined on the inside. Unless specified or shown otherwise, wall pipes shall be flange end type.

- b. Wall pipes shall be cast and/or fabricated and lined in one manufacturer's facilities and delivered to the job site ready for use.

Part 3 Execution

3.01 Surface Preparation and Shop Painting

- A. Unless otherwise specified herein, all ductile iron pipe and fittings shall be cleaned and provided with cement and bituminous lining applied at the factory.
- B. Pipe and fittings for submerged or buried service shall be factory coated outside with an asphaltic coating conforming to AWWA C151 for ductile iron pipe, AWWA C115 for flanged pipe and AWWA C110 for fittings. Pipe and fittings which shall be exposed shall be factory coated with a general purpose rust inhibitive primer compatible with the type of paint which will be field applied in accordance with the requirements of Section 09900 of these Specifications.

3.02 Field Painting

Field painting shall be in accordance with the requirements of Section 09900 of these Specifications.

3.03 Laying

- A. Proper and suitable tools and appliances for safe and convenient handling and laying of pipe and fittings shall be used. Great care shall be taken to prevent the pipe coating from being damaged, particularly cement linings on the inside of the pipes and fittings. Any damage shall be remedied as directed by the Engineer.
- B. All pipe and fittings shall be carefully examined by the Contractor for defects just before laying and no pipe or fitting shall be laid if it is defective. If any defective pipe or fitting is discovered after having been laid, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the Contractor at Contractor's own expense.
- C. All pipes and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until they are used in the completed work. Open ends of pipe shall be kept plugged with a bulkhead during construction.
- D. Pipe laid in trenches shall be laid true to line and grade on a firm and even bearing for its full length at depths and grades as shown on the Drawings. Adequate precautions shall be taken to prevent floatation of pipelines prior to backfilling. Installation of ductile iron pipe in underground pressure piping systems shall conform to the requirements of AWWA C600. Excavation of trenches and backfilling around pipes shall conform to the requirements of Section 02225 of these Specifications.
- E. All ductile iron piping laid underground shall have a minimum of 48-inches of cover above the top of the pipe unless otherwise shown on the Drawings.

- F. All elbows, tees, brackets, crosses, and reducers in pressure piping systems shall be adequately restrained against thrust. Underground pressure piping containing unharnessed push-on or mechanical joints or expansion joints shall be restrained by thrust blocks. Thrust blocks shall consist of 3,500 psi concrete conforming to the requirements of Section 03010 of these Specifications and shall be of the size and shape as shown on the Drawings. The Contractor may use forms or earth walls to mold the thrust blocks. When earth walls are used, they shall be cut true to shape and all excess earth shall be removed. The work shall be conducted so that no loose earth will become mixed with the concrete. At the end of 24 hours, damp earth may be placed over the concrete to retain moisture.
- G. All ductile iron pipes entering buildings or basins shall be adequately supported between the structure and undisturbed earth to prevent breakage resulting from settlement of backfill around the structure.
- H. All ductile iron pipe installed under buildings or basins shall be encased in 3,500 psi concrete. The size of the encasement concrete shall be a minimum of 6-inches larger than the outside diameter of the pipe.
- I. Wall pipe and wall sleeves shall be accurately located and securely fastened in place before concrete is poured. All wall pipe and sleeves shall have wall collars properly located to be in the center of the wall where the respective pipes are to be installed.
- J. Wall pipe and wall sleeves shall be installed when the wall or slab is constructed. Blocking out or breaking of the wall for later installation will not be permitted.
- K. Cutting or weakening of structural members to facilitate pipe installation will not be permitted. All piping shall be installed in place without springing or forcing.
- L. Exposed ductile iron piping shall be supported as shown on the Drawings.

3.04 Cutting

- A. Whenever pipe requires cutting to fit the lines, the work shall be done in such a manner as to leave a smooth end at right angles to the axis of the pipe. When a piece of pipe is cut to fit into the line, no payment will be made for the portion cut off and not used.
- B. Whenever existing pipe requires cutting to install new fittings, the work shall be done in such a manner as to leave a smooth end at right angles to the axis of the pipe and special care shall be exercised to guard against breaking or splitting the existing piping.
- C. All cutting of ductile iron pipe shall be done with a cutting saw. All burrs shall be removed from the inside and outside edges of all cut pipe.

3.05 Joining

Ductile Iron Piping and Ductile Iron and Cast Iron Fittings**A. Mechanical Joints**

1. The successful operation of the mechanical joint specified requires that the spigot be centrally located in the bell and that adequate anchorage shall be provided where abrupt changes in direction and dead ends occur.
2. The surfaces with which the rubber gasket comes in contact shall be brushed thoroughly with a wire brush just prior to assembly to remove all loose rust or foreign material which may be present and to provide clean surfaces which shall be brushed with a liberal amount of soapy water or other approved lubricant just prior to slipping the gasket over the spigot end and into the bell. Lubricant shall be brushed over the gasket prior to installation to remove loose dirt and lubricate the gasket as it is forced into its retaining space.
3. Joint bolts shall be tightened by the use of approved wrenches and to a tension recommended by the pipe manufacturer. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This may be done by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side and last, the remaining bolts. This cycle shall be repeated until all bolts are within the range of acceptable torques. If effective sealing is not attained at the maximum torque indicated above, the joint shall be disassembled and reassembled after thorough cleaning. Overstressing of bolts to compensate for poor installation shall not be permitted.
4. After installation, bolts and nuts in buried or submerged piping shall be given two heavy coats of a bituminous paint.

B. Flanged Joints

1. All flanges shall be true and perpendicular to the axis of the pipe. Flanges shall be cleaned of all burrs, deformations, or other imperfections before joining. Flanged joints shall be installed so as to ensure uniform gasket compression. All bolting shall be pulled up to the specified torque by crossover sequence. Where screwed flanges are used, the finished pipe edge shall not extend beyond the face of the flange, and the flange neck shall completely cover the threaded portion of the pipe.
2. Connections to equipment shall be made in such a way that no strain is placed on the equipment flanges. Connecting flanges must be in proper position and alignment and no external force may be used to bring them together properly.
3. After installation, bolts and nuts in buried or submerged piping shall be given two heavy coats of a bituminous paint.

C. Push-On Joints

1. The inside of the bell and the outside of the pipe from the plain end to the guide stripe must be wiped clean immediately before assembling the pipe joint. Then

the rubber gasket shall be inserted into a groove or shaped recess in the bell. Both the bell and spigot ends to be joined shall be wiped again to ensure they are thoroughly clean. A liberal coating of special lubricant furnished by the pipe manufacturer shall be applied to the outside of the pipe from the plain end to the guide stripe and to the inside of the gasket. The plain end shall be centered in the bell and the spigot pushed home. Wherever possible the pipe shall be socketed by hand; however, jacking may be required to push the spigot in place on the larger sizes of pipe. The completed joint shall be permanently sealed and watertight.

2. Whenever pipe is cut in the field, the cut end shall be conditioned so it can be used in making up a joint by filing or grinding the cut end to remove burrs or sharp edges that might damage the gasket.

D. Permissible Deflection of Joints

1. Deflection of ductile iron pipe at joints for long radius curves or for avoiding obstacles shall be permitted only upon approval of the Engineer.
2. Where deflection of joints is permitted, such deflection shall be made in accordance with and shall not exceed limits provided in Section 9b.5 and Section 9c.4 as applicable, of AWWA C600.

- E. Joints of Dissimilar Metals: When a flanged joint consists of a ductile iron flange mated to a steel or alloy flange, the steel flanges shall be flat faced and furnished with full-faced gaskets, insulating bushings, and stainless steel bolts.

3.06 Cut-Ins to Existing Piping

- A. In general and unless otherwise shown, cut-ins to existing ductile iron piping for installation of new mechanical joint fittings and valves shall be made using cast iron solid or cutting-in sleeves.
- B. Solid or cutting-in sleeves shall have a pressure rating not less than that of the existing pipeline and cutting-in sleeves shall be furnished with a mechanical joint end on one end and a plain end on the other.

3.07 Drilling and Tapping

- A. Wherever required ductile iron pipe and fittings and cast iron fittings shall be drilled and tapped to receive drainage or any other piping. All holes shall be drilled accurately at right angles to the axis of any pipe or fitting. Where plugs are drilled, holes shall be at right angles to the face of the plug.
- B. Where the size of the pipe to be connected is such as to require bosses for connection and when the pipe wall thickness is too thin to permit the effective length of pipe threads to be utilized as necessary for the size pipe being connected by threads, the Contractor shall furnish such pipe with cast-on bosses suitable for drilling, tapping, and connecting such pipe. Alternately, where shown or specified a tapped

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saddle clamp may be used in lieu of a cast-on boss. Saddle clamp shall be of the heavy-duty type with O-ring gasket and two heavy U-bolt clamps.

- C. All tapping shall be carefully and neatly done by skilled workers with suitable tools.

- D. Where connections are made between new and old piping the connections shall be made in a thorough and workmanlike manner using proper fittings and specials to suit actual conditions.
- E. Cut-ins to existing and operating pipelines shall be done at times agreeable to the Owner upon approval of the Engineer.
- F. Existing pipelines that may be cut or damaged during the performance of work under this item shall be repaired, reconnected, and returned to service in equal or better condition in which they were found and in accordance with the requirements of this Section.
- G. No separate payment will be made for drilling, tapping, making connections, cut-ins, repairs to damaged existing pipelines, and reconnections in existing pipelines.

3.08 Inspection and Testing

After all piping has been placed and backfilled between the joints, each run of newly laid pipe, or any valved section thereof, shall be tested by the Contractor in accordance with Section 02666 of these Specifications.

3.09 Cleaning

Prior to acceptance of the work of this Section, thoroughly clean all installed materials, equipment and related areas in accordance with Section 01710 of these Specifications.

END OF SECTION



Polyvinyl Chloride (PVC), Chlorinated Polyvinyl Chloride (CPVC) and Dual
Containment Pipe, Flexible Hose
and Sand Eductor

Part 1 General

1.01 Scope

- A. The work covered by this Section includes furnishing all labor, equipment and materials required to install and test polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) pipe, including unions, fittings, couplings, adapters and accessories as shown on the Drawings and/or specified herein.
- B. The Contractor's attention is called to the fact that all PVC piping and accessories are not necessarily shown completely on the Drawings which are more or less schematic. However, the Contractor shall furnish and install all piping indicated or required for proper operation of the equipment or services requiring such piping.
- C. PVC pipe and valves shall not be painted.

1.02 Submittals

Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01340 of these Specifications.

1.03 Storage and Protection

- A. All piping and accessories shall be stored and protected in accordance with the requirements of Section 01611 of these Specifications.
- B. All pipe and fittings shall be stored under cover.
- C. All pipe and accessories shall be stored above ground and fully supported so as not to bend or deflect excessively under its own weight. Height of stacked pipe shall not exceed four feet. Bundled pipe shall not be stacked more than two bundles high.
- D. Kinked, flattened, buckled, broken or otherwise defective pipe and fittings shall not be used and shall be removed from the site.
- E. Pipe shall be handled using nylon slings. Wire rope slings or chains shall not be used.

1.04 Quality Assurance

- A. The Contractor, at the Engineer's request, shall provide a certificate from the manufacturer of the pipe and fittings certifying that the manufacturer is fully competent and capable of manufacturing PVC or CPVC pipe and fittings of uniform texture and

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strength that will fully comply with these specifications and have so manufactured this class of pipe in sufficient quantities to be certain that it will meet all normal field conditions of usage. The manufacturer must have adequate equipment and quality control facilities to be sure that each extrusion of pipe is uniform in texture, dimensions and strength.

- B. All pipe shall be tested and inspected at the place of manufacture for all requirements of the latest ASTM and Commercial Standard tests and certified copies of the test reports covering each shipment shall be submitted to the Engineer prior to laying.
- C. Each length of pipe and each fitting shall have the following data clearly marked on each piece:
 - 1. Nominal size.
 - 2. Type and grade of material and ASTM standard.
 - 3. SDR, class or schedule rating.
 - 4. Manufacturer.
 - 5. National Sanitation Foundation's seal of approval.

Part 2 Products

2.01 Polyvinyl Chloride (PVC) Gravity Sewer Pipe

- A. Pipe and Fittings, 4 to 15-Inches in Diameter: Pipe and fittings shall be manufactured in accordance with ASTM D 3034. The minimum wall thickness shall be that which will provide an SDR of 35. The pipe shall also have a minimum pipe stiffness of 46 psi at 5 percent deflection as determined by ASTM D 2412.
- B. PVC gravity sewer pipe shall be supplied in lengths not longer than 13 feet.
- C. Fittings: Fittings for pipe 8-inches and less in diameter shall be one-piece with no solvent welded joints. Fittings for pipe 10-inches and larger in diameter may be fabricated using solvent welding. No field fabrication of fittings will be allowed. Fabrication shall be performed at the factory and the fittings shall be delivered ready for use.
- D. Joints: Joints for pipe and fittings shall be of the integral bell and spigot type with a confined elastomeric gasket having the capability of absorbing expansion and contraction without leakage. Joints shall meet the requirements of ASTM D 3212; gaskets shall meet the requirements of ASTM F 477. The joint system shall be subject to the approval of the Engineer and shall be identical for pipe and fittings.
- E. Acceptance: Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

2.02 PVC and CPVC Pressure Pipe

A. PVC and CPVC Pipe and Fittings

1. The pipe and fittings shall be homogenous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density and other physical properties.
2. The manufacturer shall provide waterstops, acceptable to the Engineer, which shall be applied to the outside of plastic pipe when the pipe is to be enclosed in any structure where concrete or mortar is used. Such waterstops will prevent leakage along the outer wall of the barrel of the pipe.
3. No single piece of pipe shall be laid on any part of the Project covered by this Specification unless it is found to be generally straight. Such pipe shall have a maximum ordinate, as measured from the concave side of the pipe, not to exceed 1/16-inch per foot of length. If the deviation from straightness exceeds this requirement, then the particular piece of pipe shall be rejected for use until it can comply with this provision.

B. Pipe

1. PVC and CPVC pipe shown on the Drawings to convey calcium hydroxide (LS), polymer (PY), liquid coagulant (COAG), liquid fluoride (FL), or liquid corrosion inhibitor (CORH.) shall be Schedule 80 PVC pipe or Type 4, Grade 1 CPVC as indicated on the Drawings. All pipe material shall be Grade 1, Type 1, polyvinyl chloride (PVC) in accordance with ASTM D 1784, Class 12454-B or Grade 1, Type 4 chlorinated polyvinyl chloride (CPVC) in accordance with ASTM D 1784, Schedule 80. All pipe material shall be National Sanitation Foundation approved for use with potable water. Maximum lengths of pipe shall not exceed 20 feet.
2. When operating temperatures exceed 140 degrees F, pipe material shall be chlorinated polyvinyl chloride (CPVC) in accordance with ASTM D 1784, Type 4, Grade 1, Class 23477-BK.

C. Fittings

1. Fittings in PVC and CPVC piping shall match pipe material. Such fitting shall comply with the requirements of ASTM D 2467 for Moulded, Schedule 80, socket welded fittings, D 2464 for threaded fittings and ANSI 150 pound for flanges. Flange bolts shall meet ANSI B16.1 (150 pound).
2. Fittings for PVC pipe used to convey gaseous chlorine shall comply with the requirements of ASTM D 2467 for Moulded, Schedule 80, socket welded fittings.

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D. PVC Valves

1. Unless otherwise shown or required, all valves, unions and strainers in PVC piping shall be constructed of Type I, Grade 1 PVC. Valves shall be NSF approved and shall have a working pressure of 150 psi.
2. Ball valves shall be as specified in Section 15100 of these Specifications.
3. Check valves shall be as specified in Section 15100 of these Specifications.

E. Solvent Welded Joints

1. Solvent welded joints shall be assembled per the manufacturer's recommendations with solvent cement complying with the requirements of ASTM D 2564 for PVC Solvent Cement.
2. All fittings shall be Schedule 80 with socket joints. Gaskets for flange fittings and unions for use with chlorine solution shall be as recommended by pipe manufacturer.

F. Dual Containment Pipe

1. All field welding shall be butt welded per the general guidelines of ASTM D-2657 for polyolefin piping, and in accordance with the manufacturer's printed guidelines.
2. Flanges shall be installed at regular intervals as deemed appropriate by the designer, to allow for ease of assembly and/or disassembly. Flanges shall be fitted with dual O-rings to simultaneously seal both the primary and secondary fluid passages. These flanges shall also provide for independent movement of fluid for both the inner and outer pipes.

- G. Detection Tape: Detection tape shall be installed over all buried plastic piping systems. Detection tape shall be composed of a solid aluminum foil encased in a protective plastic jacket. Tape shall be color-coded in accordance with APWA color codes with the following legends: Water Systems, Safety Precaution Blue, "Caution Water Line Buried Below". Colors may be solid or striped. Tape shall be permanently printed with no surface printing allowed. Tape width shall be a minimum of 2-inches when buried less than 10-inches below the surface. Tape width shall be a minimum of 3-inches when buried greater than 10-inches and less than 20-inches. Detection tape shall be equal to Lineguard Type III Detectable or Allen Systems Detectatape.

2.03 Dual Containment Pipe and Fittings (DW)

- A. The pipe supplied under this Section shall be either a very high density molecular weight polyethylene (HDPE/HDPE) or (PVC/PVC): for fluoride (FL), coagulant (COAG), chlorine (CS), corrosion inhibitor (CORH), or Polymer (PY), service. The carrier pipe shall be concentric to the containment pipe along the entire length.

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- B. Piping and fittings shall be manufactured to conform with industry standards. Piping shall be equal to DUO-PRO piping as manufactured by ASAHI America or Guardian Double Contained Pipe as manufactured by Guardian, Division of Eslon.
- C. The resin used for the manufacturer of the pipe shall be manufactured by the pipe manufacturer, thus maintaining complete control of pipe quality. The pipe shall contain no recycled compound, except that which is generated in the manufacturer's own plant from the same raw material. The pipe shall be homogenous throughout and be free of visible cracks, holes, foreign inclusions, or other deleterious defects, and shall be identifiable in color, density and other physical properties throughout.
- D. Resins used shall have all ingredients pre-compounded prior to extrusion of pipe; in-plant blending is not acceptable.
- E. Piping materials/resins shall be pre-compounded prior to extrusion of the pipe. Piping shall be homogenous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects.
- F. Termination fittings shall be used at beginnings and endings of containment piping and at valve locations.
- G. Underground piping shall be bedded as shown on the Contract Drawings.
- H. Piping and fittings shall be as manufactured by ASAHI America, or George Fischer, Inc.

2.04 Wall Sleeves

- A. For pipe sizes smaller than 3-inches, wall sleeves shall be steel oversize sleeves furnished with a full circle, integral, or continuously welded waterstop collar. The sleeve seal shall be the mechanically expanded, synthetic rubber type. Provide all associated bolts, seals and seal fittings, pressure clamps, or plates necessary to achieve a watertight installation. Sleeves shall extend the full thickness of the concrete. Sleeves and seal shall be Link Seal.
- B. For all sizes dual containment piping, the sleeve shall be PVC or polypropylene or plastic material that is chemically inert to the carrier pipe contents.

2.05 Flange Adapters

- A. The flange adaptor shall permit the connection of unthreaded, ungrooved, open-ended polyvinyl chloride pipe to ANSI/ASME B16.1, Class 125 flanges. The flange adaptor shall meet the test requirements of ANSI/ASME B16.1 for Class 125 flanges. The adaptor shall be a ductile iron casting incorporating a flange with a serrated edge, clamping bolts, and gasket. The gasket shall provide a compression seal between the adaptor, the pipe and the adjacent flange. Flange adapters are to be used only in locations specifically shown on the Drawings or at the direction of the Engineer, and in accordance with the manufacturer's recommendations. The flange adaptor shall be Uni-Flange or EBAA Iron.

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B. Bolts and Nuts

1. All bolts and nuts shall be made in the U.S.A. Bolts and nuts shall be threaded in accordance with ANSI/ASME B1.1, Coarse Thread Series, Class 2A external and Class 2B internal fit.
2. Bolts for exposed service shall be zinc plated, cold pressed, steel machine bolts conforming to ASTM A 307, Grade B. Nuts for exposed service shall be zinc plated, heavy hex conforming to ASTM A 563. Zinc plating shall conform to ASTM B 633, Type II.
3. Bolts for submerged service shall be stainless steel machine bolts conforming to ASTM A 193, Grade B8. Nuts shall be heavy hex, stainless steel conforming to ASTM A 194, Grade 8.

2.06 Retainer Glands

Retainer glands shall be ductile iron and shall be equal to EBAA Iron 1100 PV or Uni-Flange Model 1300.

2.07 Flexible Hose – Sand Transfer

- A. The tube shall be constructed Type D₃ (natural rubber) black. Equal to Gatos Ruber #429W.
- B. Reinforcement: Synthetic, high tensile texture.
- C. Cover: Type D (SBR). Black with yellow strip for easy identification.
- D. Couplings: Gate mode/#36 (sandblast).

2.08 Sand Eductor

- A. The sand eductor shall be capable of conveying 100 pounds per hour of silica sand with a specific gravity of 2.65 when supplied with 70 SCFM air at 2 psig.
- B. Eductor shall be constructed from 316 stainless steel.
- C. Unit shall be 1 ½" equal to Schutte & Koerting FIG. 218p.

Part 3 Execution

3.01 Installation

- A. All provisions with respect to trenching, backfilling, bedding, and pipe laying shall conform to the applicable requirements of Section 02225 of these Specifications.

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- B. Exposed piping shall be supported in accordance with the requirements of Section 15094 of these Specifications. Metal valves and valve boxes shall be supported independently of piping. PVC piping shall be isolated from direct contact with metal or concrete supports by a 1/32-inch sheet of neoprene.
- C. When a joint consists of a PVC flange and a metal flange, the metal flange shall be flat faced and furnished with a full face, resilient gasket.
- D. Where specifically shown or called for on the Drawings, service line taps into PVC pipe shall be made using tapping saddle constructed for use on PVC pipe. The saddle shall be constructed of bronze or brass, shall have all stainless steel bolts or screws and have a resilient rubber gasket to provide a positive, watertight seal.
- E. PVC pipe laid underground shall have a minimum of 48-inches of cover in traffic areas and 30-inches of cover in non-traffic areas.
- F. Dual containment pipe shall be either butt welded or flanged connection.

3.02 Cutting

- A. When new or existing pipe is required to be cut, the pipe shall be cut in such a manner as to leave a smooth end normal to the axis of the pipe.
- B. All cutting of polyvinyl chloride pipe shall be performed with a cutting saw. All burrs shall be removed from the inside and outside edges of all cut pipe. All damaged linings and coatings shall be repaired.

3.03 Joint Assembly

- A. Push-On Joints: The inside of the bell and the outside of the pipe from the plain end to the guide stripe shall be wiped clean immediately before assembling the pipe joint. Then the rubber gasket shall be inserted into a groove or shaped recess in the bell. Both the bell and spigot ends to be joined shall be wiped again to ensure they are thoroughly clean. A liberal coating of special lubricant furnished by the pipe manufacturer shall be applied to the outside of the pipe. The plain end shall be centered in the bell and the spigot pushed home.
- B. Mechanical Joints
 - 1. The surfaces with which the rubber gasket comes in contact shall be brushed thoroughly with a wire brush just prior to assembly to remove all dirt or foreign material which may be present and to provide clean surfaces which shall be brushed with a liberal amount of soapy water or other approved lubricant just prior to slipping the gasket over the spigot end and into the bell. Lubricant shall be brushed over the gasket prior to installation to remove loose dirt and lubricate the gasket as it is forced into its retaining space.

2. Joint bolts shall be tightened by the use of wrenches and to a tension recommended by the pipe manufacturer. When tightening bolts, the gland shall be brought up toward the pipe bell. If effective sealing is not attained at the maximum torque indicated above, the joint shall be disassembled and reassembled after thorough cleaning. Overstressing of bolts to compensate for poor installation shall not be permitted.

C. Flanged Joints

1. All flange adapters shall be installed true and perpendicular to the axis of the pipe. Flanged joints shall be installed so as to ensure uniform gasket compression. All bolting shall be pulled up to the specified torque by crossover sequence. The finished pipe edge shall not extend beyond the face of the flange.
2. Connections to equipment shall be made in such a way that no torque is placed on the equipment flanges. Connecting flanges must be in proper position and alignment and no external force may be used to bring them together properly.
3. Bolts and nuts for exposed or submerged service shall be coated in accordance with the requirements of Section 09900 of these Specifications.

- D. Solvent-Welded Joints: All solvent-welded joints shall be in accordance with ASTM 2855.

3.04 Polyethylene Pipe Joining and Handling

- A. Sections of dual containment pipe and fittings shall be joined into continuous lengths on the job site above ground. The joining method shall be the butt fusion method and shall be performed by qualified persons and in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements, alignment and fusion pressures.
- B. HDPE flanges shall be provided where HDPE joins CPVC or PVC pipe or fittings. Stainless steel bolts and nuts shall be used to connect the flanges.
- C. Fused segments of polyethylene pipe shall be handled so as to avoid damage to the pipe. When lifting fused section of pipe, chains or cable type chokers must be avoided. Nylon slings are required. Spreader bars are recommended when lifting long fused sections. Care shall be exercised to avoid cutting or gouging the pipe.

3.05 Constructing Beneath and Beyond Structures

- A. Construct piping beyond buildings of structures in accordance with Section 02610 of these Specifications.

Polyvinyl Chloride (PVC), Chlorinated Polyvinyl Chloride (CPVC) and Dual Containment Pipe, Flexible Hose

- B. All polyvinyl chloride pipe installed under buildings or basins shall be encased and backfilled in accordance with Sections 02200 and 02225 of these Specifications.
- C. All polyvinyl chloride pipe entering buildings or basins shall be adequately supported between the structure and undisturbed earth to prevent damage resulting from settlement of backfill around the structure.

3.06 Constructing within Structures

- A. Proper and suitable tools and appliances for safe and convenient handling and laying of pipe and fittings shall be used. Any damage shall be remedied as directed by the Engineer.
- B. All pipe and fittings shall be carefully examined by the Contractor for defects just before installing and no pipe or fitting shall be installed if it is defective. If any defective pipe or fitting is discovered after having been installed, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the Contractor at Contractor's own expense.
- C. All pipes and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are used in the completed work. Open ends of pipe shall be kept plugged with a bulkhead during construction.
- D. All elbows, tees, brackets, crosses, and reducers in pressure piping systems shall be adequately restrained against thrust.
- E. Wall pipe and wall sleeves shall be accurately located and securely fastened in place before concrete is poured. All wall pipe and sleeves shall have wall collars properly located to be in the center of the wall where the respective pipes are to be installed. Pipe passing through the sleeve shall extend no more than three feet beyond the structure with a piping joint.
- F. Wall pipe and wall sleeves shall be constructed when the wall or slab is constructed. Blocking out or breaking of the wall for later installation shall not be permitted.
- G. Cutting or weakening of structural members to facilitate pipe installation shall not be permitted. All piping shall be installed in place without springing or forcing.
- H. Exposed polyvinyl chloride piping shall be supported as shown on the Drawings and specified in Section 15094 of these Specifications.

3.07 Inspection and Testing

- A. After all piping has been placed and backfilled between the joints, each run of newly laid pipe, or any valved section thereof, shall be tested by the Contractor in the presence of the Engineer, and tests shall be in accordance with the requirements of Section 02666 of these Specifications.

Polyvinyl Chloride (PVC), Chlorinated Polyvinyl Chloride (CPVC) and Dual Containment Pipe, Flexible Hose

- B. All piping shall be subject to a hydrostatic gauge pressure equal to the rated pressure class of the pipe being tested. Dual containment pipe shall be hydrostatic tested for both the inner and outer pipes and shall be performed as outlined in the Uniform Plumbing Code Section 318 as directed by the local Administrative Authority. Specifically, a water pressure test at 1.5 times (150%) the normal working pressure of the inner pipe should be applied to both the inner and outer walls in separate tests. The allowable leakage shall be as noted in Section 02666. The duration of the test shall be a minimum of two hours.
- C. The Contractor shall take all precautions necessary to protect any equipment that might be damaged by the pressures used in the tests. Delicate equipment shall be valved off, removed or otherwise protected.
- D. All piping shall be securely anchored and restrained against movement prior to application of test pressures. Prior to the pressure test, pipe laid in trenches shall be partially backfilled adequately to secure the pipe during the test. All joints, fittings, and valves will be left open where possible. All exposed pipe, fittings, valves and joints shall be carefully examined during the pressure test.
- E. Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants, blow-offs, or air release valves are not available at the high places, the Contractor shall make the necessary taps at points of highest elevation before the test is made and insert plugs after the test has been completed.
- F. Any excessive leakage developing during the test shall be corrected at the Contractor's expense. If the defective portion cannot be located, the Contractor, at Contractor's expense, shall remove and reconstruct as much of the original work as necessary to obtain a facility meeting the specified leakage limits.
- G. After all tests on any section have been completed to the satisfaction of the Engineer, the Contractor shall carefully clean, blow out, and drain the line of all water to prevent the freezing of the same. The Contractor shall also demonstrate to the satisfaction of the Engineer that any and all lines are free from obstructions and foreign material.
- H. The Contractor shall bear the complete cost of the tests, including set-up, labor, temporary piping, blocking, gauges, bulkheads, water, air, soap solutions and any other materials required to conduct the tests.

3.08 Insulation and Heat Tracing

Provide insulation and heat tracing in accordance with Section 15250 of these Specifications.

3.09 Disinfection

After installation and testing, all piping shall be disinfected in accordance with the requirements of Section 02675 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to the provisions of Division 1 and Section 15050, 15060, 15062, 15069.
- B. Design, furnish and install pipe hangers, supports and brackets necessary to install piping furnished under these Contract Documents. Provide all foundations, shims, hangers, clamps, supplemental steel, fasteners, anchor bolts and other hardware required for the complete installation as shown on the Drawings and specified herein.
- C. The Drawings do not show every pipe hanger or support location, but are intended to provide a guide as to type and usage of pipe hangers and supports required by this Project. The Contractor shall provide all pipe hangers and supports required to securely support all piping in accordance with the referenced standards.
- D. In general, pipe supports shall refer to items which support pipe from below and hangers refer to items which support pipe from above.

1.02 Submittals

- A. Submit shop drawings and product data under provisions of Division 1 and Section 15050.
- B. Submit pipe hangers and support materials, locations, structural steel connections, supplemental support steel, miscellaneous hardware and hot dip galvanizing procedure for materials not factory galvanized.
- C. Submit pipe hanger and support assembly drawings including location drawings identifying member to which the hanger or support will be attached and a bill of materials for each assembly.

1.03 Quality Assurance

- A. Work shall be installed by workers experienced in the selection, fabrication and installation of pipe support systems.
- B. Selection, fabrication and installation of pipe hangers and supports shall conform to the requirements of ANSI/ASME B31.1, MSS SP-58, SP-69 and SP-89, except as supplemented or modified by the requirements of these Specifications.
- C. Weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection.
- D. Pipe support system shall utilize standard manufactured hangers and supports wherever possible.

Pipe Hangers and Supports

- E. Pipe support materials in contact with piping shall be compatible with the piping materials such that neither shall have a deteriorating action on the other.
- F. Supplemental steel shall be designed per AISC Steel Construction Manual and the Standard Building Code.
- G. All supporting equipment shall be designed with a minimum safety factor of 5 based on the ultimate tensile strength of the material.

1.04 Project Conditions

- A. Building structure shall be erected under other sections of these Specifications and should be essentially complete prior to starting work under this Section. Where elements of pipe hanger and support systems require inserts into concrete, the Contractor shall be responsible for providing and installing approved pipe hanger and support components prior to placing the concrete.
- B. The Contractor shall be responsible for coordinating shop drawings of all structural elements to which pipe hanger and support connections will be made with shop drawings for pipe hangers and supports. Where pipe hangers and supports are to be installed in existing structures, the Contractor shall be responsible for field verifying existing or as-built dimensions prior to fabrication of pipe hanger and support systems.

1.05 Sequencing and Scheduling

The Contractor shall coordinate scheduling of pipe hanger and support installation with the piping system installation to prevent any damage to installed piping due lack of pipe supports.

Part 2 Products**2.01 Acceptable Manufacturers**

Pipe hangers and supports shall be manufactured by Grinnell, B-Line Systems, Michigan Hanger Company, Aickenstrut, or Jove.

2.02 General Materials and Construction

- A. Contact between ferrous supports and non-ferrous piping materials shall not be permitted. Supports and clamps shall be rubber coated or copper-plated as necessary to prevent this condition.
- B. All supports and hangers shall meet the following material requirements:
 - 1. All structural steel and hot rolled steel rod shall conform to ASTM A 36.

2. All pipe support columns shall conform to ASTM A 53, Grade B and shall be minimum Schedule 40.
 3. All rod and bolting materials, unless specified otherwise, shall conform to ASTM A 307, Grade B. Nuts shall be heavy hex nuts conforming to ASTM A 307.
 4. All carbon steel or malleable iron straps, hangers, clamps, U-bolts and other hardware in contact with the pipe shall be shop primed except where specified or shown on the Drawings to be galvanized.
 5. Expansion type anchor bolts shall be stainless steel and as specified in Section 05501 of these Specifications.
 6. Flat strap hangers shall not be permitted. Hangers relying on mastics or adhesives shall not be used.
- C. Steel or concrete pipe supports for all piping between undisturbed earth and face of structures shall be in accordance with the details shown on the Drawings.
- D. All interior and exterior concrete piers shall be Class "A" concrete meeting the requirements of Section 03300 of these Specifications.

2.03 Pipe Hangers for Horizontal Piping

- A. Uninsulated Pipes: Steel, double bolt pipe clamp, equal to Anvil Figure 295.
- B. Uninsulated Pipe Using Pipe Clevis Hanger: Adjustable clevis hanger equal to Anvil Figure 260.
- C. Insulated Pipes: Steel, adjustable clevis pipe hanger, equal to Anvil Figure 300.
- D. Long runs of pipe subject to expansion shall be hung by means of adjustable swivel pipe roll hangers equal to Grinnell, Figure 177.
- E. Short runs of uninsulated pipe subject to expansion in sizes up to and including 3-1/2-inches as well as all pipe of those sizes not subject to expansion shall be hung by means of adjustable swivel, split pipe ring equal to Anvil, Figure 104.
- F. Insulated piping and tubing, short lengths of 4-inches and larger pipe subject to expansion, and pipe 4-inches and larger not subject to expansion shall be hung by means of adjustable steel clevis hangers equal to Grinnell, Figure 300. Corrosion resistant clevis hangers shall be constructed of fiber reinforced plastic (FRP) and shall be equal to Jove FPH Series.
- G. Uninsulated copper tubing shall be hung by means of copper-plated, split ring hangers with copper-plated sockets equal to Anvil Figure CT-109.

2.04 Pipe Supports for Horizontal Piping

- A. Pipe 2-inches and less in diameter and not subject to expansion may, when paralleling walls, be supported by single hook clamp hangers equal to Grinnell, Figure 126.
- B. Pipe supported from underneath and subject to expansion shall have adjustable pipe roll stand supports equal to Anvil, Figure 274. The pipe roll stand shall be supported by concrete piers, structural steel or steel brackets as required.
- C. Pipe supported from underneath and not subject to expansion shall have cast-in-place concrete supports or adjustable pipe saddle supports on properly sized pipe stanchions and ample, properly grouted floor flanges. Saddle supports shall be equal to Anvil, Figure 265.
- D. When supports are installed exterior to buildings, provide a 1/4-inch drain hole near the base.

2.05 Pipe Riser Clamps for Vertical Piping

- A. Steel riser clamps, equal to Anvil Figure 261.
- B. Provide insulation protection shields for insulated piping.

2.06 Miscellaneous Hardware

- A. C-Clamp with Locknut: Steel, equal to Anvil Figure 92 (3/8" rod), Anvil Figure 98 (1/2" rod) or Anvil Figure 94 (5/8" - 3/4" rod). C-clamps shall be provided with retaining clips.
- B. Hanger Rods: Continuously threaded, steel, equal to Grinnell Figure 146.
- C. Welded Eye Hanger Rods: Steel, threaded at end, left or right hand thread as required, equal to Anvil Figure 278 or 278L.
- D. U-Bolts: Steel with four finished hex nuts, galvanized, special dimensions as required for installation, equal to Grinnell Figure 137 (137S for special dimensions).
- E. Turnbuckle: Forged steel construction, equal to Anvil Figure 230.
- F. Threaded Rod Coupling: Malleable iron, equal to Anvil Figure 136 (136R for reducing).
- G. Hangers suspended from structural steel shall be supported on U.F.S. beam clamp equal to Anvil, Figure 228L or 292L with links as required.

- H. Hangers from concrete work shall be secured by universal, galvanized metal inserts equal to Grinnell, Figure 282, placed in the concrete at the time of pouring. Wooden plugs or other improvised means shall not be used for any form of hanger fastening.
- I. Protection Saddles: Protection saddles shall be equal to Anvil Figure 160 or 161.
- J. Insulation Shields: Insulation shields shall be galvanized with a 180 degree contour equal to Anvil Figure 167.
- K. Shock absorbing devices for shock and sway suppression shall be equal to Anvil Figure 200.

2.07 Supplemental Steel

- A. Utilize standard steel shapes fabricated in accordance with ASTM A 36.
- B. Prime and paint supplemental steel support brackets and assemblies after all fabrication procedures (welding, drilling, cutting, etc.) are complete.

2.08 Non-Metallic Supports

- A. All glass fiber reinforced channel covered under this Section shall have a flame spread rating of 25 or less when tested per ASTM E 84.
- B. Glass fiber reinforced channel framing shall have a minimum pull out resistance of 1,000 pounds when a load is applied to the inside of the flanges over a 3/8-inch long section of the channel and shall not deflect more than 1/4-inch when a uniform load of 1,000 pounds is applied to a 24-inch beam. Framing shall have a surface veil over 100 percent of the surface which, along with a properly designed filler system will protect against degradation from ultraviolet light and shall be made from corrosion resistant grade polyester or vinylester resins. Framing shall be Aickenstrut Type P or V.
- C. Polyvinyl chloride channel framing shall be manufactured by the extrusion process and shall have a minimum pull-out strength of 1,400 pounds when a load is applied to the inside of the flanges over a 3/8-inch long section of the channel. Framing shall be manufactured from a UV stabilized resin. Framing shall be Aickenstrut Type E.
- D. Universal pipe clamps shall be made by the injection molding process using a polyurethane base resin, shall have full and interlocking contact with the interior area of channel flanges to maximize pull-out resistance, shall be adjustable to accommodate a minimum 3/4-inch variance in OD sizes of piping or conduit, and shall contain no metal materials. Pipe clamps shall be Aickenstrut "Aickenstrap".
- E. All fasteners shall be manufactured from long glass fiber-reinforced polyurethane.
- F. All threaded rods shall be made from vinylester resin.

Part 3 Execution

3.01 Installation

- A. Pipe hangers and supports shall be installed in complete conformance with the manufacturer's recommendations and the Contract Documents.
- B. Pipe hangers and supports shall be capable of supporting the pipe in all conditions of operation. Hangers and supports shall allow free expansion and contraction of the piping, and prevent excessive stress resulting from transferred weight being induced into the pipe or connected equipment.
- C. Intermediate pipe supports shall be provided between building structural members so as not to exceed maximum support spacing specified shall be galvanized structural steel angles (minimum 2-1/2 x 2-1/2 x 1/4-inch).
- D. If vibration is encountered after the piping system is in operation, appropriate vibration control equipment shall be installed at the direction of the Engineer.
- E. Pipe hangers and supports for building plumbing shall be provided at intervals no greater than that specified by the Standard Plumbing Code and International Building Code 2003.
- F. Pipe hangers and supports for fire protection piping shall be provided at intervals no greater than that specified by NFPA 13.
- G. Pipe hangers and supports for gas piping shall be provided at intervals no greater than that specified by the Standard Gas Code.
- H. All threaded connections installed loose, such as hanger rods and U-bolts, shall have a double nut installation.
- I. Provide pipe hangers or supports within 18-inches of each elbow and within 24-inches of each equipment connection.
- J. Pipes shall not be supported by non-loading bearing walls and partitions. Pipe hangers shall not be connected to roof decking, bar joists or ceiling suspension systems unless approved by the Engineer.
- K. Unless otherwise shown, piping shall not be fastened to a support in such a manner that would prevent axial movement due to thermal expansion and contraction.
- L. Supports, guides, and anchors shall be so designed that excessive heat will not be transmitted to the building steel. The temperature of supporting parts shall be based on a temperature gradient of 100 degrees F per inch distance from the outside surface of the pipe.
- M. No pipe shall be supported from floor grating.

- N. The Contractor shall size supports and hangers using actual field dimensions.
- O. Corrosion resistant channels shall be attached to walls by rigid PVC base posts secured with 316 stainless steel hex head bolts, minimum 4-inch embedment.

3.02 Installation - Horizontal Piping

- A. Spacing of hangers and supports for above ground horizontal piping shall be in accordance with ANSI/ASME B31.1 and MSS SP-69.
- B. Carbon steel, alloy steel, stainless steel and hard-drawn copper pipe shall be supported on maximum intervals as follows:

Pipe Size	Maximum Interval For Steel		Maximum Interval For Copper
	Water	Steam, Air, Gas	
1/2"	5'	6'	4'
3/4"	6'	7'	5'
1"	7'	9'	6'
1-1/2"	9'	11'	8'
2"	10'	13'	9'
2-1/2"	11'	14'	1'
3"	12'	15'	11'
4"	13'	17'	-
6"	17'	21'	-
8"	19'	24'	-
10"	22'	27'	-
12"	23'	29'	-
14"	25'	32'	-
16"	27'	35'	-
18"	28'	37'	-
20"	30'	39'	-
24"	32'	42'	-

- C. Annealed copper tubing and polyethylene tubing shall be supported on maximum intervals as follows:

Pipe Hangers and Supports

Tubing Size	Maximum Interval For Copper	Maximum Interval For Polyethylene
3/8" & Smaller	-	2'
1/2" - 5/8"	6'	3'
3/4" - 1-1/8"	8'	4'
1-1/4" - 2"	10'	5'
2-1/2" - 5"	12'	-
6" - 8"	14'	-
10"	18'	-

- D. Uninsulated PVC and CPVC piping shall be supported on maximum intervals as follows at design temperatures up to 80 degrees F:

Pipe Size	Maximum Intervals		
	PVC Schedule 40	PVC Schedule 80	CPVC Schedule 80
1/2" - 3/4"	4'	4'	4'
1"	4'	5'	5'
1-1/4" - 1-1/2"	5'	5'	6'
2"	5'	6'	7'
2-1/2"	5'	6'	8'
3"	6'	7'	8'
4"	6'	7'	9'
6"	6'	8'	10'

- E. Pipe hangers and supports shall be installed at intervals recommended for a specific application by the piping system manufacturer.
- F. Cast iron or ductile iron piping shall be supported as recommended by the pipe manufacturer, and at all valves and fittings larger than 4-inches in size. At least one support shall be provided per pipe section or at every other joint, whichever is closer. Supports shall be located next to hubs or bells.
- G. Provide all necessary steel angles and other items required to maintain the minimum hanger or support spacing.
- H. Wherever possible, pipe attachments for uninsulated horizontal piping shall be pipe clamps.
- I. Wherever possible, structural attachments shall be beam clamps.

J. Pipe Hangers

1. Pipe hangers, trapeze hangers, upper attachments and other supports shall be selected based on pipe material, size and service conditions. Provide all hangers and rods, turnbuckles, angles, channels and other structural supports to support the piping systems. The minimum rod diameter for single pipe rigid rod hangers shall be as follows:

Pipe Size	Minimum Hanger Rod Diameter For Steel, Ductile and Cast Iron Soil Pipe	Minimum Hanger Rod Diameter For Copper And Plastic Pipe
2" & smaller	3/8"	3/8"
2-1/2" & 3"	1/2"	1/2"
4" & 5"	5/8"	1/2"
6"	3/4"	5/8"
8", 10" & 12"	7/8"	3/4"
14"	1"	7/8"
16" & 18"	1"	-
20" & 24"	1-1/4"	-

2. Hangers shall permit a minimum of 1-1/2-inch vertical adjustment after installation.
3. Where the piping system is subject to shock loads, such as seismic disturbances or thrusts imposed by the actuation of safety valves, pipe hangers shall include shock absorbing devices.
4. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit swing. Where lateral or axial movement cannot be tolerated, provide sway bracing for rods exceeding 10 feet.
5. Where horizontal piping movements are greater than 1/2-inch, or where the hanger rod angularity from the vertical is greater than 4 degrees from the cold to hot position of the pipe, the hanger pipe and structural attachments shall be offset in such a manner that the rod is vertical in the hot position.
6. Hangers shall be designed so that they cannot become disengaged by movements of the supported pipe.
7. Hangers shall be sized to fit around insulation.

- K. Additional hangers and supports shall be provided as required so that there is no movement or visible sagging between supports.
- L. Where indicated on the Drawings or directed by the Engineer, exposed piping and tubing carrying liquid shall be sloped as necessary to permit complete draining. Pipe deflection between supports shall be considered when determining the slope required to permit complete drainage.
- M. Pipe Supports for Floor Supported Horizontal Piping: Pipe supports for horizontal piping supported on concrete floors and on concrete bases shall be adjustable pipe saddle support with U-bolt and screwed floor flange. Bolt floor flange to floor and bases utilizing all bolt holes. Use foam glass inserts at all saddles, sleeves, etc.
- N. Open ends of pipe columns used for support shall be completely covered with 1/4-inch thick plate or angle leg welded in place.

3.03 Installation - Vertical Piping

- A. Supports for all pipes shall fit directly around the pipe, except that on insulated pipes, the support shall be insulated and provided with vapor barrier.
- B. Vertical pipes passing through floors shall be provided with a riser clamp at each floor. Riser clamps shall have steel lugs, 1/3-inch thick x 2-inches high x 1-1/2-inches long, welded to the clamp arms so that clamp does not come in contact with the pipe sleeve.
- C. Vertical piping shall be supported as shown or required to prevent buckling or swaying utilizing special brackets. Unless otherwise shown, vertical piping shall be supported at the bottom and at each floor. Vertical copper tubing 1-inch and smaller in size shall be supported at five foot intervals.

3.04 Insulation Shields and Saddles - Horizontal Piping

- A. Minimum insulation shield requirements unless otherwise noted:
 - 1. Pipes 2-Inches and Smaller: 18 gauge x 12-inches long.
 - 2. Pipes 2-1/2-Inches and Larger: 16 gauge x 12-inches long.
- B. Shields shall be 180 degree type at all pipe hangers, except that on trapeze hangers, pipe rack and on floor supported horizontal pipes shields shall be 360 degree type. Use foamglass inserts at all shields, hangers, sleeves, etc.
- C. Galvanized pipe clamps, including bolts and nuts, shall be provided with the framing channels and shall be used for securing pipes to channels. Pipe clamps on insulated pipes shall fit around pipe, pipe insulation and pipe insulation protection shield.

- D. Insulation on hot piping (carrying fluids above 70 degrees F) shall be protected at supports and hangers with a 12-inch long galvanized steel protection saddle with welded center support. Protection saddle shall be equal to Grinnell Figure 160 or 161.
- E. Insulation on cold piping (carrying fluids at 70 degrees F or below) shall be protected at supports and hangers by galvanized steel insulation shields with a 180 degree contour. Insulation shields shall be equal to Grinnell Figure 167.
- F. On insulation finished with an aluminum jacket, a 1/32-inch thick sheet of neoprene shall be provided between the jacket and the shield.

3.05 Supplemental Steel

- A. All supplemental steel shall be fabricated in accordance with the requirements of the AISC Manual of Steel Construction and the Standard Building Code.
- B. No flame cutting of galvanized steel members will be permitted.
- C. All galvanized surfaces damaged or exposed by cutting or drilling shall be resurfaced in accordance with ASTM A 780.

3.06 Surface Preparation and Shop Painting

Fabricated pipe supports and accessories, except where shown on the Drawings to be galvanized, shall be cleaned and shop primed in accordance with the requirements of Section 09900.

3.07 Field Painting

Field painting all pipe hangers, supports and accessories shall be in accordance with the requirements of Section 09900.

3.08 Cleaning

Prior to acceptance of the work of this Section, thoroughly clean all installed materials, equipment and related areas in accordance with Section 01710.

END OF SECTION



Part 1 General

1.01 Scope

The work covered by this Section includes furnishing all labor, equipment and materials required to furnish and install pipe couplings and expansion joints, including flanged adapters, expansion couplings, and rubber expansion joints, as shown on the Drawings, specified herein, and/or required for proper installation of piping and equipment.

1.02 Submittals

Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01340 of these Specifications.

1.03 Storage and Protection

Pipe couplings shall be stored and protected in accordance with the requirements of Section 01640 of these Specifications.

1.04 Quality Assurance

The manufacturer shall provide written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.

Part 2 Products

2.01 Materials and Construction

A. Expansion Couplings

1. Unless otherwise shown or specified, expansion couplings shall be of a gasketed, short sleeve type, with a diameter to properly fit the pipe. Expansion couplings shall have a working pressure of not less than 150 psig.
2. Each short sleeve coupling for joining cast iron or ductile iron pipe shall consist of one cylindrical cast iron middle ring without pipe stop, two high-grade malleable iron or steel followers, two rubber compound, wedge section gaskets and a sufficient number of track head, electroplated steel bolts to properly compress the gaskets. Cast iron couplings shall be equal to Dresser Style 153 or Rockwell Style 441.
3. Each short sleeve coupling for joining steel pipe shall consist of one cylindrical steel middle ring without pipe stop, two steel follower rings, two rubber compound, wedge section gaskets and a sufficient number of track head, electroplated steel bolts to properly compress the gaskets. Steel couplings shall be equal to Dresser Style 38 or Rockwell Style 411.

Pipe Couplings and Expansion Joints

4. Where expansion couplings are required for joining cast iron pipe to steel pipe of the same nominal size, steel transition couplings equal to Dresser Style 62 or Rockwell Style 413 shall be used.
5. Rubber gaskets shall be composed of a resilient synthetic rubber compound suitable for use in wastewater containing oil and grease.

B. Flanged Adapters

1. Flanged adapters shall be used for joining plain end cast iron or ductile iron pipe to flanged valves, pumps and fittings. Flanged adapters shall be suitable for working pressures to 150 psig.
2. Flanged adapters in sizes 12-inches and smaller shall consist of an ASTM A 126, Class B cast iron flanged body drilled to mate with a 125 pound cast iron flange per ANSI B16.1, a cast iron follower ring, a rubber compound, wedge section gasket, a sufficient number of track head and electroplated steel bolts to properly compress the gasket.
3. Flanged adapters in sizes 12-inches and larger shall consist of a high strength steel, flanged body drilled to mate with a 125 pound cast iron flange per ANSI B16.1, a high strength steel follower ring, a rubber- compound, wedge section gasket, a sufficient number of track head and electroplated steel bolts to properly compress the gasket.
4. Rubber gasket shall be composed of a resilient synthetic rubber compound suitable for use in wastewater containing oil and grease.

C. Flanged Rubber Expansion Joints

1. Flanged rubber expansion joints shall be standard spool-type single or multiple arch expansion joints constructed of abrasion resistant rubber reinforced with high tensile strength synthetic fabric and steel rings.
2. Ends of the expansion joint shall be integral with the body and shall be full faced and drilled per ANSI B16.1 for 125 pound flanges. Beveled and split, galvanized steel retaining rings shall be provided to prevent damage to flanges and to distribute bolting stresses during assembly.
3. Tube, body and flanges shall be constructed using Buna-N for wastewater, natural rubber for clean water and Buna-N or neoprene for air. For working temperatures in excess of 180 degrees F or for chemical service, the tube, body and flanges shall be constructed of viton. The exterior of the expansion joint shall be coated with Hypalon to resist weathering.
4. When used to convey slurries, raw water or untreated wastewater in horizontal piping, arches shall be filled with a special soft rubber compound integrally cured in the arches.

5. In unrestrained piping systems or pipe systems subject to excessive longitudinal deflection, joints shall be furnished with two plated steel control rods filled with nuts to limit compression and extension and prevent damage to the joint.
 6. Rubber expansion joints shall be "Redflex", as manufactured by Red Valve Company, or "Invincible Expansion Joint", as manufactured by Mercer Rubber Company, subject to the requirements of this Section.
- D. Slip-On Rubber Expansion Joints
1. Slip-on rubber expansion joints for low pressure applications (less than 15 psig) up through 6-inch diameter in size shall be sleeve-type, single-arch expansion joints constructed of abrasion resistant rubber reinforced with high tensile strength synthetic fabric.
 2. Ends of the joint shall be designed to slip over pipe ends and shall be secured in place with adjustable stainless steel clamps. Two clamps shall be provided on each end of the joint.
 3. Joints shall be constructed of Buna-N for wastewater and Buna-N or neoprene for air at working temperatures up to 180 degrees F.

2.02 Tools and Spare Parts

The Contractor shall furnish two spare gasket sets and two spare track head bolt sets for each size and type of coupling.

Part 3 Execution

3.01 Installation

- A. Pipe couplings and expansion joints shall be installed where shown on the Drawings, required, or directed by the Engineer. Couplings and joints shall be installed in strict conformance with the manufacturer's instructions.
- B. Pipe ends shall be cleaned, brushed, or filed to produce a mating surface for the gasket that is free from dirt, rust, chuck marks, mill scores, dents, burrs or other foreign substances that would impede proper gasket seating.
- C. A lubricant recommended by the coupling manufacturer shall be used in seating all gaskets.
- D. On expansion couplings and flanged adapters, bolts shall be tightened diametrically opposite each other and in progression so that the inner rims project an equal distance over the flares of the middle ring at all points. Bolts shall be tightened sufficiently to insure a watertight joint but shall not be tightened beyond the point of stretching.

3.02 Surface Preparation and Shop Painting

A. Couplings and adapters shall have finish as follows:

Material	Location	Primer	Finish
Cast Iron	Buried or Submerged	Asphaltic Varnish Inside & Out	-
Cast Iron	Exposed	Asphaltic Varnish (Interior)	-
Cast Iron	Exposed	Primer (Exterior)	Field Applied
Steel	Buried or Submerged	Epoxy Primer Inside & Out	Coal Tar Epoxy
Steel	Exposed	Primer (Exterior)	Field Applied
Steel	Exposed	Epoxy Primer (Interior)	Coal Tar Epoxy (Interior)

B. Coatings used for couplings and adaptors in potable water shall be approved for use with potable water.

3.03 Field Painting

Following installation and testing, couplings shall be field painted in accordance with the requirements of Section 09900 of these Specifications. Rubber expansion joints shall not be painted.

3.04 Inspection and Testing

Following installation, operating tests will be performed to demonstrate to the Engineer that the pipe coupling and expansion joints will function in a satisfactory manner. The Contractor shall make, at Contractor's own expense, all necessary changes, modifications and/or adjustments required to ensure satisfactory operation.

3.05 Cleaning

Prior to acceptance of the work of this Section, thoroughly clean all installed materials, equipment and related areas in accordance with Section 01710 of these Specifications.

END OF SECTION

3. Actuators
 - a. Valves for non-buried service, 3 through 8-inches in diameter, shall be lever operated. Hand levers shall be steel with a non-metallic grip. The lever shall be a universal locking type capable of being locked in any position.
 - b. Valves for buried service or non-buried service, 10-inches or greater in diameter shall be equipped with [traveling nut, self-locking type or geared] manual actuators designed, manufactured and tested in accordance with AWWA C504. Actuators shall be capable of holding the disc in any position between full open and full closed without any movement or fluttering of the disc. Actuators shall be furnished with fully adjustable mechanical stop-limiting devices. Actuators that utilize the sides of the actuator housing to limit disc travel are unacceptable. Valve actuators shall be capable of withstanding a minimum of 450 foot pounds of input torque in either the open or closed position without damage.
 - c. Actuators for buried valves larger than 10-inches shall be mounted above ground using an extended bonnet except when the valve is located in paving or has 8 feet or less cover.
 - d. Valves shall be equipped with motorized actuators where shown on the Drawings.
4. Operators
 - a. Valves for non-buried service, six feet or more above the operating floor shall be furnished with a chainwheel operator and chain for operation from floor level. All other valves shall be equipped with a handwheel operator.
 - b. Valves for buried service shall have a nut type operator and shall be equipped with a valve box and stem extension required to bring the operation nut within 6-inches of finished grade. Valve boxes and extension stems shall be as specified in this Section.
 - c. Valves shall be equipped with pedestal type operators where shown on the Drawings and as specified in this Section.
5. Valves shall be installed with disc shaft horizontal, except where extended bonnets are used. Valves and actuators shall have seals on all shafts and gaskets on valve actuator covers to prevent the entry of water. Actuator mounting brackets shall be totally enclosed and shall have gasket seals.
6. Valve ends for buried service, 48-inches and less, shall be mechanical joint type, except where flanged or restrained joint ends are shown. Flange joints shall meet the requirements of ANSI B16.1, Class 125.

D. Check Valves

1. Check valves shall be hinged disc type with cast iron body and bronze or bronze-fitted disc. Valves shall be designed for the operating head indicated and shall not slam shut on pump shutdown. Valves shall be equipped with a 1/2-inch stop cock at the high point of the valve for bleeding air from the line.
2. Valves shall be outside weight and lever cushioned type. The cushion chamber shall be attached to the side of the valve body externally and constructed with a piston operating in a chamber that will effectively prevent hammering action at the pump discharge heads specified. The cushioning shall be by air, and the cushion chamber shall be so arranged that the closing speed will be adjustable to meet the service requirements.

E. Air Release Valves**1. For Water Service**

- a. The valve shall be a combination air/vacuum - air release valve and shall consist of an automatic air/vacuum valve with an air release valve tapped into its body. The valve shall be of two-piece body design with an isolation valve separating the two valves. Single body valves are not acceptable. The air/vacuum valve shall discharge large amounts of air as the pipeline fills and allow air to enter the pipeline as it drains or in the event of vacuum conditions. The valve shall operate by means of a non-collapsible stainless steel float which seals an orifice. As air enters the valve the float shall drop from the orifice and allow the air to escape. As water rises in the valve, the float will again seal the orifice. The valve will be of such design that the float cannot blow shut at any air velocity. All working parts shall be of stainless steel. The inside of the valve body shall be epoxy coated.
- b. The air release valve tapped into the air/vacuum valve shall be of a design that automatically discharges small amounts of air which collect at system highpoints during normal operation of a pipeline. The valve shall operate by means of a non-collapsible, stainless steel float which rests against an orifice seat while the valve is closed. As air enters the valve displacing the water inside, the float will drop away from the orifice, allow the air to escape, then close water tight. The valve body shall be constructed of cast iron, with the inside coated with epoxy. All internal parts shall be made of stainless steel. The orifice diameters shall be as indicated on the Drawings. The valve outlet shall be equipped with a stainless steel elbow, equal in diameter, threaded into the outlet to protect the valve seat from debris.
- c. Each valve shall be equipped with a minimum 1/2-inch NPT tapped in the body with a test cock installed as indicated on the Drawings.

- F. Pinch Valves: Valves are to be of the full metal body, mechanical pinch type with flanged joint ends on both body and rubber sleeve. Port areas shall be 100 percent of the full pipe area through the entire valve length. All internal valve metal parts are to be completely protected by the flexible elastomer pinch tube. The elastomer pinch tube shall be one-piece construction with integral flanges drilled to ANSI 125# standard. The pinch tube shall also be nylon reinforced with an exterior wrapping of 1/8-inch thick neoprene. Closing mechanism shall be double-acting and pinch the sleeve equally from two sides. Valves shall be suitable for buried service and have non-rising stems equipped with standard 2-inch square flared nuts. The valves shall have face to face dimensions of standard gate valves, according to specification ANSI B16.10 to 6-inch size and no longer in length than twice the diameter in sizes larger than 6-inches. There shall be no cast parts in the operating mechanisms.
- G. Needle Valves: Chemical feed needle valves shall be non-shock, thermoplastic type of Type 1, Grade 1 PVC with O-ring stem seal and Teflon stem seat. Valve shall withstand 150 psi pressure and shall incorporate a positive stop for safe operation. All parts shall be corrosion resistant materials, specifically suited for process chemical.
- H. Diaphragm Valves
1. Iron Body Valves
 - a. Valves shall be of the straight-through, full flow design. Valves shall have a natural rubber lined cast iron body with flanged connections conforming to ANSI/ASME B16.1, Class 125. The diaphragm shall be natural rubber.
 - b. Valve actuators shall be manual or pneumatic as shown on the Drawings. Manual valves shall be handwheel operated, rising-stem type. Actuators shall be provided by the valve manufacturer, mounted on the valve and ready for connection of air piping.
 - c. Valves shall have a localized mechanical position indication of open and closed.
 - d. All hardware shall be 316 stainless steel.
 2. Thermoplastic Valves
 - a. Valves shall be constructed of sch 80 CPVC. Diaphragms shall be EPDM except for Sodium Hypochlorite which shall be Viton or Teflon. "O" rings shall be EPDM or Viton for Hypochlorite. Diaphragm backing shall be Teflon. All valves shall have positive stop stem with built-in position indicator and polypropylene handwheel.
 - b. Valve through two inches shall be true Union type and shall be rated at 150 psi for water at 73° F. Valves three inches and four inches shall be flanged with flanges conforming to ANSI/ASME B16.1 Class 125 and shall be rated at 150 psi. All metal parts and hardware shall be 316 stainless steel.

- I. Flap Valve: Provide resilient seated flap valve for gravity flow conditions as shown on the Drawings. Valve body and flap shall be cast iron ASTM A 126-B. Flange shall be drilled for anchor bolt mounting. Resilient seat shall be wide seating Buna N, bonded in a groove machined into valve body. Hinge arms shall be high tensile bronze ASTM B 584-CA865. Hinge pins shall be ASTM B 98-CA655 or Type 304 stainless steel. Each arm shall have two pivot points. A lubrication fitting shall be provided for each pivot. Anchor bolts shall be expansion type with minimum 6-inch embedment. Anchor bolts shall be 304 stainless steel.

- J. Pressure Sensors
 - 1. Line pressure shall be sensed by a flexible cylinder lining and transmitted via a captive sensing liquid to the gauging mechanisms.
 - 2. The sensor body shall be full line size, constructed of carbon steel and mounted in-line as shown on the Drawings. The sensor body shall be constructed with ANSI 125 pound flange connections, or in a wafer body design to fit between ANSI 125 pound flanges.
 - 3. The manufacturer shall provide the sensor complete with gauges, pressure switches, or other accessories as shown on the Drawings and herein specified.
 - 4. Captive liquid chamber shall be factory-filled; provide fill and bleed valves for field filling.

- K. Pressure Gauges: Pressure gages shall have bronze or stainless steel bourdon tube elements. Lens shall be heavy glass, with oil-resistant gasket seal. The dial shall be a minimum of 4.5-inches in diameter, with white coated metal lithographed with black metal graduations and numerals. The mounting as required. Connection shall be 1/4-inch NPT with square wrench surface. Provide cartridge snubber and polished brass gauge cock. Range shall be as shown on the Drawings. Accuracy shall be \pm 0.5 percent.

- L. Valve Boxes (VB): Valve boxes shall be adjustable cast iron.

- M. Pedestal Operators for Valves (PO)
 - 1. Non-g geared pedestal operators shall be equipped with indicators to show valve position.
 - 2. Geared pedestal operators shall have ball thrust bearings and shall be equipped with valve position indicator and crank type handle.

- N. Stem Guides (SG): Fully adjustable stem guides with bronze bushings shall be installed as shown on the Drawings and wherever necessary to prevent unsupported stem lengths of 10 feet or more.

- O. Extension Stems: Extension stem shall be stainless steel and shall be furnished by the manufacturer of the associated valve to bring the operating nut to within 6-inches

of finished grade.

2.03 Fire Hydrants (FH)

- A. Fire Hydrants: Fire hydrants shall conform to AWWA C502. Hydrants shall conform to the standards of the Northern Kentucky Water Service District and as shown on the plans. All fire hydrants shall have auxiliary valves for isolating water flow to the hydrant. All fire hydrants and auxiliary valves shall be positively locked to the water main by restrained joints, hydrant adapters, or other approved method.

Hydrants shall be designed to 200 psi working pressure and shall be shop tested to 300 psi hydrostatic pressure with the main valve both open and closed. The barrel shall have a breakable safety section and/or base bolts just above the ground line. Hydrants shall have a main valve opening of 5 1/4 inches, a 6-inch mechanical joint inlet to be suitable for setting in a trench 3' 6" deep minimum, and shall be the traffic style hydrant so that the main valve remains closed when the barrel is broken off. Hydrants shall have a dry top and shall be self draining, when the main valve is closed. Self draining hydrants shall drain to dry wells provided exclusively for that purpose. Hydrant drains shall not be connected to storm or sanitary sewers. Hydrants located generally in the Covington System and other areas determined by the District (flood zones) shall have all drain holes plugged prior to installation. Hydrants shall be rotatable in a minimum of eight (8) positions in 360 degrees. All hydrants shall have two (2)-two and one half (2 1/2) inch hose nozzles and one (1) steamer or pumper connection threaded to conform to Northern Kentucky Water Service District Standards: steamer nozzle shall be National Standard Thread and 2 1/2" outlets shall be Northern Kentucky Water Service District Standard Thread (Old Cincinnati Thread). The operating nut and the nuts of the nozzle caps shall be square in shape, measuring one (1) inch from side to side. Hydrant body shall be painted yellow for areas designed for 150 psi working pressure and red for areas in excess of 150 psi. Hydrants used in areas in excess of 150 psi working pressure shall be designed to operate at the higher pressures and shall have independent operating valves on each 2 1/2" outlet.

All hydrants shall be right hand open, clockwise, except in certain areas of Campbell Co. as specified in Standard Drawings and shall have a direction arrow of operation cast into the dome of the hydrant. Installation per Standard Drawing #109.

- B. Installation: The installation of fire hydrants shall be in conformance with "Mains Installation" section, paragraph "Setting Hydrants".
- C. Polyethylene Encasement: Fire hydrant tee, anchoring pipe and part of the fire hydrant shoe shall be encased with Polyethylene film conforming to ANSI A21.5 (AWWA C105). (See Standard Drawings #109).

2.04 PVC Ball Valves (PBLV)

Ball valves shall be non-shock thermoplastic of Type 1, Grade 1 PVC with O-ring stem seal and Teflon ball seat. O-ring seals shall be Viton. Valves shall withstand 150 psi pressure. Valves furnished for (Hypochlorite) shall be vented ball valves

designed to relieve pressure build up from internal fluid entrainment. A 1/8" vent hole in the ball shall equalize internal fluid pressure. O-rings shall be Viton. Install valves with ball vent on the pressure (upstream) side when in the closed position. Valves shall have union connections at each end.

2.05 PVC Ball Check Valves (PBCV)

Ball check valves shall be non-shock thermoplastic type of Type 1, Grade 1 PVC with O-ring ball seal. O-ring seals shall be Viton. The valve shall have a true union connection for easy removal. The valve shall operate in the vertical or horizontal position.

2.06 Motorized Actuators

A. Type I, Open-Close or Modulating, Heavy Duty

1. Actuator shall be an electric motor driven gear reducer with integral controls for motorized and manual operation or rising and non-rising stem valves. The actuator shall be provided and sized by the valve manufacturer to meet the maximum torque requirements of the valve. The actuating unit shall be mounted on and assembled to the valve. The actuator shall provide quarter-turn operation for plug, butterfly and ball valves and multi-turn operation for gate and globe valves.
2. Each motor shall be high torque, totally enclosed in a NEMA rated housing. The motor starting torque shall be equal to 2-1/2 times the running torque. The motor shall have AIEE standard Class F insulation. The grease tight operation shall be assured by the use of dual motor shaft seals.
3. The gearing shall be combined helical/spur and worm gear type, accurately machined. Helical gears shall be alloy steel, hardened and ground. Gearing shall be grease lubricated, with high speed parts on anti-friction bearings. An inspection plate on the housing shall be provided to allow inspection of the handwheel declutching mechanism, the motor gears, and for relubrication.
4. Each unit shall include a handwheel for manual operation of the valve drive sleeve through direct gearing. The handwheel shall not rotate during electrical operation. The motor shall not rotate during hand operation. In no case will the handwheel ever be connected with the motor. When the unit is being operated manually, it shall be automatically returned to the electric operation when the handwheel is released.
5. The transfer from electric to manual operation shall be accomplished by a declutching lever arm which will disengage the motor mechanically but not electrically. The unit shall be capable of being clutched or declutched when operated electrically with no damage to the clutch or gear mechanism.
6. The actuator shall operate the valve from full open to full closed in 60 seconds.

7. The controls shall provide a reversing actuator, mechanical and electrical interlock, and thermal overload relays. The contactor shall break all lines to the motor.
8. The actuator shall operate on a 208 volt, three phase power supply. All controls shall operate on 115 volt AC power and a control power transformer shall be provided within the unit as required. Actuators to be located outdoors shall have a control enclosure heater to prevent condensation.
9. Position limit switches shall be provided for both open and close positions of travel and shall be connected directly to the valve through continuous gearing, and follow its position at all times. END position limits (open, closed) shall be set using a screwdriver with a maximum of five revolutions of the screw.
10. Dual or a double acting, adjustable torque limit switch shall be provided, capable of deleting excessive torque caused during seating, unseating, or obstructions. Torque control accuracy shall be within \pm five percent.
11. The controls shall provide for local and remote operation. The pushbutton control shall be provided with open, close and stop pushbuttons, open and close indicator lights, and local/remote selector switch. The controls shall include a transmitter for remote indication of valve position.
12. The actuator and controls shall be furnished in a NEMA 4 enclosure as an integral part of actuator.
13. Actuators for modulating service (filter rate of flow controllers #1, 2 and 3 and main backwash valve) shall contain all the design and control features as required for the open/close actuators. In addition, they shall contain the following controls:
 - a. Actuators shall accept pulse position control signal.
 - b. Actuators shall be capable of a maximum pulse rate of 100 starts per hour with an accuracy of \pm two percent.
 - c. Actuators shall have a system adjustment span of zero - deadband.
 - d. Valve fail position upon loss of command signal shall be field selectable to "fail-open", "fail-closed", or "fail-as is".
 - e. Actuators shall be capable of transmitting a 4-20 mA signal for remote indication of valve position. This signal shall be generated by a resistance to current (R/I) converter.
 - f. All controls and field terminal connections shall be contained integral to the actuator.

- B. Type II, Medium Duty, Open/Close or Modulating
1. Actuator shall be a reversible electric motor driven gear reducer with integral controls for motorized operation of small diameter, non-rising stem, quarter-turn operated PVC ball valves and butterfly valves. The actuator shall be provided and sized by the valve manufacturer to meet the maximum torque and control requirements of the valve.
 2. The actuator shall operate the valve from full open to full closed in 5 seconds.
 3. The actuator shall operate on a 120 VAC power supply.
 4. The actuators and controls shall be rated NEMA 4X and shall include the following:
 - a. Reversing Starter
 - b. Open/Stop/Close Pushbutton control
 - c. Open/Close Indicator lights
 - d. Local/Off/Remote Selector Switch
 - e. Adjustable Open/Close Limit Switches
 - f. Open/Stop/Close Control from a remote location
 5. The actuator shall have the following options:
 - a. Two limit switches
 - b. Heater and thermostat
 - c. Manual override
 - d. Adjustable 5 second - 14 minute cycle length control
 - e. Mechanical brake

Part 3 Execution

3.01 Installation

- A. All valves and appurtenances shall be installed in the locations shown on the Drawings, true to alignment and properly supported. Any damage to the above items shall be repaired to the satisfaction of the Engineer before they are installed.

- B. Install all floor boxes, brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Drawings that are in masonry floors or walls, and install concrete inserts for hangers and supports as soon as forms are erected and before concrete is poured. Before setting these items, the Contractor shall check all plans and figures which have a direct bearing on their location and he shall be responsible for the proper location of these valves and appurtenances during the construction of the structure.
- C. Pipe for use with flexible couplings shall have plain ends as specified in the respective pipe sections.
- D. Buried flanged or mechanical joints shall be made with cadmium plated bolts. All exposed bolts shall be made with cadmium plated bolts. All exposed bolts and nuts shall be heavily coated with two coats of bituminous paint.
- E. Prior to assembly of split couplings, the grooves as well as other parts shall be thoroughly cleaned. The ends of the pipes and outside of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap or graphite paste, and the gasket shall be slipped over one pipe end. After the other pipe has been brought to the correct position, the gasket shall be centered properly over the pipe ends with the lips against the pipes. The housing sections shall then be placed. After the bolts have been inserted, the nuts shall be tightened until the housing sections are firmly in contact without excessive bolt tension.
- F. Prior to the installation of sleeve type couplings, the pipe ends shall be cleaned thoroughly for a distance of 8-inches. Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6-inches from the end, and the middle ring shall be placed on the already laid pipe end until it is properly centered over the joint. The other pipe end shall be inserted into the middle ring and brought to proper position in relation to the pipe already laid. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares. After the bolts have been inserted and all nuts have been made-up fingertight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferably by use of a torque wrench of the appropriate size and torque for the bolts.

3.02 Surface Preparation and Shop Painting

Ferrous surfaces of valves and appurtenances shall receive a coating of rust-inhibitive primer compatible with the finish paint specified in Section 09900 of these Specifications.

3.03 Field Painting

All metal valves and appurtenances specified herein and exposed to view shall be painted as part of the work in Section 09900 of these Specifications.

3.04 Inspection and Testing

Following installation, operating tests will be performed to demonstrate to the Engineer that all equipment and accessories will function in a satisfactory manner. The Contractor shall make, at Contractor's own expense, all necessary changes, modifications and/or adjustments required to ensure satisfactory operation.

3.05 Cleaning

Prior to acceptance of the work of this Section, thoroughly clean all installed materials, equipment and related areas in accordance with Section 01710 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope (MP-FERRIC-SP-1; MP-HYPO-SP-1; MP-FL-SP-1; MP-CAUSTIC-SP-1; MP-SPARE-SP-1)

Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of chemical sump pumps, motors and controls. All equipment shall be installed, adjusted, tested and placed in operation in accordance with these Specifications and the manufacturer's recommendations.

1.02 Qualifications

The pump manufacturer shall have similar units in operation for a minimum of five years in the United States.

1.03 Design Requirements

- A. Pump shall be corrosion-resistant submersible sump pumps.
- B. The pump manufacturer shall review design and layout drawings to insure that installation arrangements are suitable for their equipment. Any potential conflicts or recommended modification shall be noted on the shop drawings or by a pre-submittal request for information if appropriate. Any modifications required to satisfy manufacturer's recommendations shall be at the Contractor's expense.

1.04 Factory Testing

The pump manufacturer shall conduct full scale, full range factory performance tests with respect to capacity, head and horsepower on each of the pump units to be provided on this Project.

1.05 Submittals

- A. Submit shop drawings and engineering data in accordance with the requirements of Section 01340 of these Specifications. Specific submittal information shall include:
 - 1. Pump manufacturer's name, pump size or model number, weight and a descriptive bulletin of the pump to be furnished.
 - 2. Outline dimension drawings of the pump.
 - 3. Pump characteristic curves showing head capacity and horsepower, including minimum head, rated and shutoff conditions.
- B. Operation and maintenance manuals shall be furnished in accordance with the requirements of Section 01730 of these Specifications.

1.06 Storage and Protection

- A. Pump and accessories shall be stored and protected in accordance with the manufacturer's recommendations.
- B. Pump volutes shall be completely drained prior to shipment. Suction and discharge ports shall be provided with plastic plugs. Each pump shall be secured to a wooden skid to facilitate handling and storage.

1.07 Quality Assurance

The manufacturer shall provide a written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

Sump pump shall be Camac SMVC-25.

2.02 Operating Requirements

- A. Operating requirements for sump pump shall be in accordance with Table 1 of this Section.
- B. The operating range of the pump shall include minimum head, rated and shut-off conditions. The pump shall be non-overloading throughout this operating range.
- C. The pump manufacturer shall conduct full scale, full range factory performance tests with respect to capacity, head and horsepower. Tests shall be conducted in accordance with applicable Hydraulic Institute standards.

2.03 Sump Pump

- A. General: Provide heavy duty, centrifugal extended shaft, sump pump constructed of corrosion-resistant materials suitable for pumping Chemical Building washdown waters. The waters to be pumped may contain chemical leakage from ferric sulfate, fluoride, caustic, sodium hypochlorite or polymer piping. The system shall be provided with a control panel. Pump design and construction shall completely prevent solution-to-metal contact. All wetted materials shall be CPVC.
- B. Casing: Casing, bolts and nuts shall be Carpenter 20 for MP-FERRIC-SP-1, 316 Stainless Steel for MP-CAUSTIC-SP-1 and Hastelloy C for all others.
- C. Impeller: Impeller shall be constructed of tough corrosion-erosion resistant plastic and dynamically balanced to provide vibration-free service. Impeller shall be semi open design.

- D. Shaft: Shaft shall be large diameter, 316 stainless steel construction, keyed to the impeller, and designed for minimum deflection. Shaft shall be encased in a heavy plastic sleeve which completely isolates the shaft from the liquid being pumped.
- E. Seal: Lightly loaded vapor seal shall protect outboard bearing and motor from corrosive fumes.
- F. Motor: Motor shall be designed and manufactured in accordance with NEMA standards and shall have the following characteristics:
- Design B
Horsepower as shown in Table 1
3,600 RPM
460 volt, 60 Hz, 3-phase
Class B insulation
1.15 Service Factor
TEFC, chemical duty
- G. Control Panel: The panel shall provide one main circuit breaker, one or two NEMA size 1 FVNR motor starter and a duplex, 120 VAC convenience receptacle. Power shall be provided to each panel at 480 V, 3-phase, 60 Hz. The vendor shall provide 120 volt transformer, protected in accordance with NEC, for all control power. The control panel shall require only power and the connection of a level device to be fully operational. The control panel shall be a pre-wired NEMA 4X fiberglass design and shall contain components to perform the following functions:
1. "Fault" indication and alarm (with Form C dry contacts for remote indication).
- H. Foot Valve: Pump suction shall be fitted with a corrosion proof foot valve to maintain liquid seal within suction line at low sump levels.

Part 3 Execution

3.01 Installation

Installation shall be in strict accordance with the manufacturer's recommendations in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. Anchor bolts shall be set in accordance with the manufacturer's recommendations.

3.02 Shop Painting

Pump and accessories shall be cleaned, shop primed and shop painted in accordance with the requirements of Section 09900 of these Specifications.

3.03 Inspection and Testing

After the pump has been completely installed, the Contractor, under the direction of the manufacturer's representative, shall conduct, in the presence of the Engineer, such tests as are necessary to ensure that pump capacity and operation conform to the Specifications. Field tests shall include the pump included under this Section. The Contractor shall supply all electrical power necessary to complete field tests.

3.04 Manufacturer Service

A factory representative, who has complete knowledge of proper operation and maintenance, shall be provided to instruct the Owner's personnel on proper operation and maintenance. This work may be conducted in conjunction with the inspection of the installation and test run. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional services shall be provided at no additional cost to the Owner.

3.05 Cleaning

Prior to acceptance of the work of this Section, thoroughly clean all installed equipment, materials and related areas in accordance with Section 01710 of these Specifications.

TABLE 1
SUMP PUMP SCHEDULE

Location	Spill Containment
Equipment No.	MP - FERRIC-SP-1 MP-HYPO-SP-1 MP-FL-SP-1 MP-CAUSTIC-SP-1 MP-SPARE-SP-1
Rated Capacity, GPM	40
Rated Head, feet	32
Shut Off Head feet	45
Fluid Pumped	Any
Sump Depth, feet	2.0
Horsepower	1.5
Maximum RPM	3,600
Voltage	480
Carnac Model No.	SMVG-25

END OF SECTION



Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to the provisions of Section 15050.
- B. Furnish and install markers, tags and nameplates for heating, ventilating, air conditioning, plumbing and fire protection equipment, piping, controls, and valves to fully identify these items.
- C. Furnish a complete list of all equipment, piping, controls and valves with coordinated designations and locations for each device.

1.02 References

American National Standards Institute (ANSI) Standards: A13.1 Scheme for the Identification of Piping Systems

1.03 Submittals

- A. Submit product data in accordance with Sections 01340 and 15050 of these Specifications.
- B. Submit catalog cuts, product samples, installation instructions and any other information required to determine compliance with the Contract Documents.
- C. Submit complete list of equipment, piping, controls and valves with identification codes and locations. Coordinate this list with the equipment identifications utilized in other sections of the Specifications and by the various trades involved in the work.

1.04 Quality Assurance

- A. All materials of a similar type shall be the product of a single manufacturer.
- B. Identification materials shall be manufactured by a company regularly producing this type of product. Materials used shall be specifically manufactured for identification purposes.

1.05 Sequencing and Scheduling

- A. Coordinate installation of identification devices with the installation of the mechanical equipment.
- B. Installation of identification devices may be done at the equipment manufacturer's factory.
- C. Install identification devices prior to final testing and balancing of the mechanical systems.

Part 2 Products

2.01 Acceptable Manufacturers

Mechanical identification items shall be manufactured by W.H. Brady Company, Seton Name Plate Corporation, or Champion America, Inc.

2.02 Pipe Markers

- A. Markers and direction-of-flow arrows for piping which will be accessible for maintenance shall be of semi-rigid plastic.
- B. Letter sizing shall be manufacturer's standard, graduated in accordance to the pipe size.
- C. Marker background color and letter color shall be coded to identify pipe contents in accordance with ANSI A13.1.
- D. Provide pipe markers with acrylic facing for stainless steel piping subject to halogen corrosion.

2.03 Valve Markers

- A. Provide 1-1/2-inch diameter polished brass markers, not less than 19 gauge thickness.
- B. Letters shall be 1/4-inch high. Numbers shall be 1/2-inch high. Both letters and numbers shall be stamped and black-filled.
- C. Valve marker fasteners shall be either meter seals, four-ply 18 gauge smooth copper wire, brass "S" hooks, or brass jack chain.
- D. Markers shall bear indications corresponding to the notations on the framed wiring diagrams, control diagrams and operating instructions.

2.04 Equipment Nameplates

- A. Provide 2-1/2 x 3/4-inch aluminum nameplates with black enamel background and either etched or engraved lettering.
- B. Provide corrosion-resistant fasteners.
- C. Nameplates shall bear indications corresponding to the notations on the framed wiring diagrams, control diagrams and operating instructions.

2.05 Control Nameplates

- A. Provide laminated white plastic nameplates with black lettering.

- B. Each switch position shall be clearly indicated.
- C. Word nameplates to identify the respective product and function.
- D. Provide corrosion-resistant fasteners.

Part 3 Execution

3.01 Pipe Markers

- A. Install adjacent to each valve and fitting, except on plumbing fixtures and equipment at each branch and riser take-off.
- B. Install at each pipe passage through wall, floor and ceiling construction.
- C. Install at each pipe passage to underground.
- D. Install on 25 foot centers on horizontal pipe runs.

3.02 Valve Markers

Fasten to valve body in a manner which will facilitate being easily read.

3.03 Equipment Nameplates

Mount securely to the appropriate piece of equipment.

3.04 Control Nameplates

Mount securely to the appropriate control device such that switch position and control function are easily read.

3.05 Valve List Frame

Secure on mechanical room wall; mount one valve list in frame.

END OF SECTION



Part 1 General

1.01 Scope

- A. All work specified in this Section is subject to the provisions of Section 15050.
- B. Design, furnish and install mechanical vibration control and isolation devices of the type specified or as required for proper operation of the mechanical equipment specified in other sections of the Contract Documents.

1.02 Coordination

- A. The isolation devices and channel frames shall be products of a single vibration isolation manufacturer. Submittal data shall include size, type, load and deflection of each isolator selected. Submittal data shall also include clearly outlined procedures for setting and adjusting all isolation devices. The isolation manufacturer's representative shall maintain an adequate stock of springs and isolators of the type used so that any changes required during construction and checking can be accomplished promptly.
- B. Coordinate the vibration isolation supports with the manufacturers of the equipment to be isolated. Prior to submitting detailed shop drawings to the Engineer for review, the equipment manufacturer shall approve the shop drawings in writing.
- C. Special care should be taken when selecting vibration isolators and housekeeping pad thickness to insure sufficient height to the drain pan outlet to allow installation of the water seal and sufficient slope to the floor.

Part 2 Products

2.01 Acceptable Manufacturers

Vibration isolators shall be manufactured by Mason Industries, Amber/Booth, or Vibration Mountings, Inc. provided the equipment meets or exceeds the requirements of the Contract Documents.

2.02 Description

- A. All vibration isolators shall be furnished with zinc electro-plated hardware to prevent corrosion and bolt freeze-up and to maintain attractive appearance. To prevent corrosion, steel or cast iron housing shall be treated by phosphating and painting while aluminum housing shall be etched in ChromiCoat solution and painted.
- B. Hanger type vibration isolators shall contain a steel spring and 0.3-inch deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box.

Mechanical Vibration Control

- C. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 15 degree arc before contacting the hole and short circuiting the spring. Springs shall have minimum additional travel to solid height equal to 50 percent of the rated deflection.
- D. Provide steel spring isolation at air handling units. Isolators shall be sized for deflection of 1-inch.

Part 3 Execution

3.01 Installation

- A. Vibration isolators shall be installed in complete conformance with the manufacturer's recommendations and the Contract Documents. After installation, the isolation manufacturer's representative shall check the various isolators and certify that they have been installed in accordance with his recommendations. Three copies of the certifying letter shall be submitted to the Engineer.
- B. Vibration isolators shall be the product of one manufacturer.
- C. Vibration isolators for piping risers shall be installed at riser clamps.

END OF SECTION

Mechanical Insulation and Heat Tracing

Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to the provisions of Section 15050.
- B. Furnish and install thermal insulation for equipment, ductwork, piping and tanks as indicated below.

1.02 References

- A. The latest edition of the testing standards indicated below shall be used as test procedures to verify compliance of submitted products with performance standards specified herein. Manufacturers of submitted products shall certify that materials furnished are tested in accordance with these standards.
 - 1. American Society for Testing and Materials (ASTM) Standards
ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
 - 2. National Fire Protection Association (NFPA) Standards
NFPA 255 Method of Test of Surface Burning Characteristics of Building Materials
 - 3. Underwriters Laboratories, (UL) Standards
UL 723 Test for Surface Burning Characteristics of Building Materials

1.03 Quality Assurance

- A. Insulation products shall have a Flame Spread Rating not exceeding 25 and Smoke Developed Rating not exceeding 50.
- B. Insulation or duct liner shall not emit volatile organic compounds or other noxious substances through "off gassing" or promote the growth of fungi or bacteria.
- C. Installation shall be performed by workers skilled in the fitting and installation of insulation products.

1.04 Submittals

- A. Submit product data in accordance with the provisions of Sections 01340 and 15050.
- B. Submit catalog cuts, performance data, sealing tape, mastic and all other information required to demonstrate compliance with the Contract Documents.

- C. Submit manufacturer's installation instructions.

Part 2 Products

2.01 Acceptable Manufacturers

Insulation products shall be manufactured by CertainTeed, Knauf, Johns Manville, Owens-Corning, IMCOA, Pittsburgh-Corning and Armstrong.

2.02 Equipment Insulation

- A. Equipment insulation shall be glass fiber board with factory applied foil-skrim-kraft vapor barrier. Thermal conductivity shall not exceed 0.23 BTU·in/hr/Ft²/F at 75 degrees F.
- B. Equipment carrying conditioned air located in mechanical rooms or other service areas shall be provided with 1-inch thick insulation of the type indicated below unless insulation has been factory-furnished by equipment manufacturer.

2.03 Ductwork Insulation

- A. Board type insulation material shall be fiberglass, minimum density 3 lbs/cu. ft., and thermal conductivity of 0.23 BTU·in/hr/Ft²/F at 75 degrees F mean temperature. Facing shall be factory applied 0.02 perm (maximum) vapor barrier, consisting of glass fiber scrim reinforced laminated facing of aluminum foil and Kraft paper. Board type insulation applications include, but are not limited to – Exposed rectangular ductwork.
- B. Blanket type insulation material shall be fiberglass, minimum density 1lb/cu. ft., and maximum thermal conductivity of 0.27 BTU·in/hr/Ft²/F at 75 degrees F mean temperature. Facing shall be factory applied 0.02 perm (maximum) vapor barrier, consisting of glass fiber scrim reinforced laminated facing of aluminum foil and Kraft paper. Blanket type insulation applications include, but are limited to – Exposed round ductwork; concealed round and rectangular ductwork; exposed backside of ceiling diffusers.
- C. All ductwork carrying conditioned (heated or cooled) supply, return or exhaust air located in attic, ceiling space, concealed or other non-conditioned areas shall be insulated with 2-inch thick insulation.
- D. All ductwork carrying conditioned (heated or cooled) supply or return air located in or passing through mechanical rooms, general process areas, or other service areas shall be insulated with 1-inch thick insulation.
- E. All ductwork carrying outside air to heating or air conditioning equipment shall be insulated with 2-inch thick insulation.

- F. All ductwork carrying conditioned (heated or cooled) air located outdoors or otherwise exposed to weather shall be insulated with 2-inch thick board type insulation and coated with waterproof mastic.
- G. All ductwork between wall louvers or roof vents and shut-off dampers shall be insulated with 2-inch thick insulation.
- H. FRP ductwork serving chemical storage and feed areas shall not be insulated.

2.04 Pipe Insulation

- A. Materials (Indoor Piping for Temperatures Above 150° F or Piping over 4-inches in Diameter)
 - 1. Piping insulation shall be performed glass fiber molded to cover pipe in two pieces with longitudinal joints. The insulation shall be covered with factory applied, all-service jacket with self-sealing lap strip. Thermal conductivity shall not exceed 0.23 BTU in/hr/Ft²/°F at 75 degrees F.
 - 2. Valve and fitting insulation shall be preformed glass fiber, covered with preformed PVC fitting covers. Thermal conductivity shall not exceed 0.23 BTU in/hr/Ft²/°F at 75 degrees F.
 - 3. Insulation products shall be equal to Owens Corning Fiberglass SSL-II.
- B. Materials (Indoor Piping for Temperatures 150° F and below and piping 4-inches or less, or refrigerant piping).
 - 1. Piping insulation shall be flexible elastomeric closed-cell type, slipped on the pipe prior to connection whenever possible. Where the slip-on technique is not possible, the insulation shall be pre-slit and snapped over the pipe with pre-applied adhesive. Butt joints shall be sealed with insulation manufacturer's adhesive or heat fuse method. Where required, the insulation shall be covered with insulation manufacturer's finish. Sealer shall be latex caulk. Thermal conductivity shall not exceed 0.27 BTU in/hr/Ft²/°F at 75 degrees F mean temperature.
 - 2. Fittings shall be insulated using fabricated fitting covers of flexible elastomeric closed-cell type insulation in accordance with the manufacturer's instructions. Join slit seams and mitered joints with insulation manufacturer's adhesive or heat fuse method.
 - 3. Insulation products shall be equal to Armstrong AP Armaflex.
- C. Materials (Outdoor Piping Exposed to Weather or Heat Traced Piping)
 - 1. Premolded cellular glass thermal insulation shall be furnished in accordance with ASTM C 552 and C 585 fabricated for standard pipe sizes, fittings and

valves.

2. Maximum thermal conductivity of 0.29 BTU in/hr/Ft²/°F at 75 degrees F mean temperature in accordance with ASTM C 177 and C 518.
 3. Maximum water vapor permeability of 0.00 perm-in when tested in accordance with ASTM E 96.
 4. Average density of 7.5 pounds per cubic foot.
 5. Maximum Flame Spread Rating of 0 and Smoke-Developed Rating of 0 when tested in accordance with ASTM E 84 and UL723.
 6. Utilize installation adhesives and joint sealants as recommended by the insulation manufacturer.
 7. Furnish 30 gauge smooth Type 316 stainless steel jacketing over insulation retained by stainless steel bands.
 8. Insulation products shall be equal to Pittsburgh Corning FOAMGLAS.
- D. Insulation Thickness: Piping insulation thickness shall be 1-inch for pipes up to 2-inches, 1-1/2-inches for pipes over 2-inches and up to 4-inches, and 2-inches for pipes over 4-inches.

2.05 Electric Heat Tracing for Piping

- A. Provide self-limiting heat trace cable where shown on the Drawings or described in these Specifications.
- B. Cable shall have 16 AWG copper bus wire with self-regulating, semi-conductive core and tinned copper braided shield over bus wire and core. Overjacket shall be modified polyolefin or fluoropolymer over shield. Cable shall provide temperature maintenance up to 150 degrees F. Cable shall be equal to Raychem Model BTV For general and Class 1, Div 2 areas.
- C. Provide all required electrical accessories, including power connection kits, splice kits, tee kits, lighted end seals, thermostats, aluminum or glass tape, and other components required for a complete operating system for each heat trace service as scheduled herein. Cable and accessories shall be FM approved for installation in NEC classified areas where indicated on the Heat Trace Schedule. Unless heat trace services are installed in NEC classified locations, all enclosures for electrical accessories shall be NEMA 4X rated. All components shall be UL-listed.
- D. Thermostats shall be the bulb type. Line sensing thermostats shall have a minimum of 9-foot capillary tube. Temperature range shall be adjustable from 25 to 150 degrees F.

- E. Ambient-sensing thermostats for non-hazardous locations shall be equal to Model AMC-1A and hazardous locations shall be equal to Model AMC-1H as manufactured by Raychem. Line-sensing thermostats for non-hazardous locations shall be equal to Model AMC-1B and hazardous locations shall be equal to Model E507S-LS as manufactured by Raychem.
- F. All chemical lines shall be controlled by individual line-sensing thermostats.
- G. Lighted end seals shall be equal to Raychem Model E-100-L-A. Splice or Tee connection kit shall be equal to Raychem Model T-100. Single entry power connection kit shall be equal to Raychem Model JBS-100. Multiple entry power/splice-tee connection kit shall be equal to Raychem Model JBM-100.
- H. Outdoor design temperatures shall be 0° F.
- I. Coordinate circuit sizing with available electrical circuits shown on the Electrical Drawings. All wiring and conduit from the junction boxes (shown on the Electrical Drawings) to the heat trace power connection kits shall be provided under this Division and installed in accordance with Division 16.
- J. Provide pipe markers cautioning "ELECTRIC HEAT TRACING - SHOCK HAZARD".
- K. Acceptable Manufacturers: Raychem, Thermon, Chromalox, and Nelson.
- L. Provide pipe heat tracing as indicated in Table 1.

Part 3 Execution

3.01 Installation

- A. Insulation shall be installed in accordance with the manufacturer's recommendations.
- B. Insulation butt joints shall be sealed with tape a minimum of 2-inches wide matching the character of the insulation vapor barrier.
- C. Insulation bonding must be by glue, self-adhesive lap or tape. Staples are not permitted. Seal all vapor barrier punctures.
- D. Surface to be insulated and insulation shall be clean and dry during installation.
- E. Insulation shall be continuous through wall or floor penetrations.

3.02 Pipe Insulation

- A. Pipe hangers shall be outside of the pipe insulation.
- B. Install pipe insulation on exterior pipe below grade to a depth at least six inches below the frost line or 30 inches below grade, whichever is greater.

Mechanical Insulation and Heat Tracing

- C. Seal edges of pipe insulation with approved mastic to create a water and vapor proof seal.
- D. Insulate all of the services listed below. Where domestic service is called out, it is defined as piping in attics, concealed above ceilings, and within walls or exposed in return air plenums, mechanical rooms, and process areas.
 - 1. Domestic potable water piping.
 - 2. Domestic non-potable water piping.
 - 3. Hot water piping.
 - 4. AC units refrigerant and condensate piping.
 - 5. Trap primer lines.
 - 6. Tempered water lines serving emergency fixtures and hose stations.
- E. Insulate all piping, valves and fittings that are heat traced in addition to those services specified herein.
- F. Paint or identify insulation on services in accordance with Sections 09900 and 15190.

3.03 Electric Heat Tracing

- A. Install heat tracing in accordance with the manufacturer's instructions prior to insulation.
- B. Apply heat tracing cable around pipe, valves and fittings as required to attain wattage densities specified herein. Do not spiral wrap pipe diameters under 2-inches. Provide additional wattage for valves and fittings in accordance with the manufacturer's instructions.
- C. Secure heat tracing cable to piping and components with glass tape. Provide aluminized Mylar heat transfer tape over and under heater and under insulation on plastic piping and valves.
- D. Coordinate heat tracing installation with electrical and insulation work.
- E. Locate pipe heat tracing identification in accordance with Section 15190 of these Specifications.
- F. Where multiple heat trace services are installed in a single area, each service shall be separately powered from an electrical junction box. Heat trace cable shall not be used as a means of power supply between separate heat trace services. Each heat trace service shall be provided with separate power connection kits, end seals, and accessories as scheduled within this Specification.

- G. Do no locate thermostats in the direct sun.

Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to the provisions of Section 15050.
- B. Furnish, install and test all materials and equipment for fire protection systems throughout the new facility, including but not limited to the following:
 - 1. Riser check valves with trim and alarm bells.
 - 2. All pipe, fittings, hangers, valves signs, alarm switches, Siamese connection, test and drain connections and sprinkler heads, as required by insuring authority and local governmental authorities having jurisdiction.

1.02 References

- A. This specification references the latest edition of the publications listed below. Work shall be performed and materials shall be furnished in accordance with these publications as reference herein:
 - 1. Kentucky State Building Code
 - 2. International Fire Prevention Code
 - 3. National Fire Protection Association (NFPA) Standards
 - 13 Installation of Sprinkler Systems (1999)
 - 101 Life Safety Code (1999)

1.03 Quality Assurance

- A. Installation shall be by a holder of a valid Certificate of Competency issued by the State of Kentucky.
- B. Material and installation shall conform in all respects to requirements of NFPA (National Fire Protection Association) standards and as required by Owner's insuring authority, and state and local authorities having jurisdiction.
- C. Materials and means of installation shall comply with NFPA 13 except where modified herein, by other codes, Owner's insurer or the authority having jurisdiction to meet more stringent requirements.

1.04 System Description

- A. Occupancy classifications, system type and criteria shall be as described on the drawings.

1.05 Submittals

- A. According to requirements of these Specifications, submit the following:
 - 1. Materials and equipment lists, including manufacturer's data and cut sheets.
 - 2. Shop drawings, including dimensioned plans, sections, details and elevations showing locations and arrangement of piping, sprinklers, valves and alarms.
 - 3. Contractor's Material and Test Certificates.
- B. Approvals shall be obtained prior to ordering materials or beginning construction.

Part 2 Products

2.01 Materials (Above Ground)

- A. Piping
 - 1. Schedule 40 steel pipe manufactured in accordance with ANSI B36.10, ASTM A795, ASTM A53, or ASTM A135 and UL-FM requirements.
- B. Fittings
 - 1. Cast iron ASTM B16.4 or malleable iron ASTM B16.3, screwed or flanged and manufactured in accordance with UL-FM listing requirements and NFPA standards. Plain end pipe fittings shall not be accepted.
 - 2. Grooved type fittings or couplings manufactured in accordance with UL-FM listing requirements and NFPA standards. Couplings shall be factory primed and painted and supplied with touch-up paint for installation. Bolts and nuts shall be zinc electro-plated carbon steel ASTM A183 with a minimum tensile strength of 110,000 psi.
- C. Hangers and Pipe Supports
 - 1. Provide suitable and substantial hangers and supports for all piping, in accordance with their UL-FM listing and NFPA standards.
 - 2. Space or locate pipe hangers and supports in accordance with NFPA standards.
 - 3. Do not attach pipe supports to ductwork or other piping.
 - 4. Hangers and pipe supports shall be galvanized or factory primed and finished.

D. Valves

1. Gate valves controlling water shall be wedge gate type, with gland followers in stuffing boxes and constructed so that valve can be repacked while open and under pressure. Valves shall also be of the "outside, screw and yoke" (OS&Y) description and shall have a UL-FM label indicating listing.
2. Globe valves for drain, test or similar connections shall be suitable for intended service and shall have easily replaceable seats.
3. Check valves shall be of swing or wafer type, as required by insuring authority and these Specifications and shall have easily replaceable clapper gaskets or seats. Valves shall have UL-FM label.
4. Riser check valves shall be equipped with required gauges and drain connection.
5. Valves shall be by Star, Reliable, or Viking.

E. Sprinklers

1. Sprinklers installed in all areas having finished ceilings shall be equal to Star "Nova Starmist" 1/2-inch NPT pendant mount, semi-recessed type with chrome finish. Ceiling escutcheon plates for such sprinklers shall be of the two piece, semi-recessed type with chrome finish.
2. Sprinklers installed in warehouse, manufacturing and other areas not having finished ceilings shall be equal to Star Galaxy Model SG, 1/2-inch or 3/4-inch upright or pendant type, with bronze finish.
3. All sprinklers shall have orifice size and temperature rating as required by insuring authority for area in which installed.
4. Furnish and install adjacent to each sprinkler riser, one approved type metal sprinkler cabinet containing not less than 12 extra sprinkler heads of the type and temperature rating used in the work and one sprinkler wrench, for emergency use.
5. Sprinkler guards shall be installed on all sprinklers located within seven feet of finished floor or mezzanine or in racks.
6. Sprinklers shall be by Tyco, Star, Reliable, or Viking.

F. Alarm Devices

1. Provide electrically operated tamper switches with two sets of SPDT Form C contacts for all gate, butterfly or post indicator type valves controlling water to sprinkler systems. Enclosure shall be die-cast aluminum with mechanical cover tamper switch.

2. Provide electrically operated vane-type flow alarm switch with cover and tamper switch for each fire service riser.
3. Provide pelton wheel type, cast aluminum water motor alarm gong and necessary trim and connections for each alarm valve.
4. If the building is provided with fire alarm system, provide interlock contact for sprinkler system to interlock to building fire alarm system.
5. All alarm devices shall be UL-listed and FM approved.
6. Alarm devices shall be by Potter-Roemer, Star, Reliable, Viking, Guardian, or Silent Knight.

G. Fire Department Connection

1. Provide freestanding or flush outlet type Fire Department connections of the Siamese type, with two, 2-1/2-inch inlets and 4-inch outlet, located where shown on the Drawings and properly connected to the riser pipe.
2. Fire Department connection shall be cast iron body and shall have a rough brass finish and be complete with aluminum identification plate, caps and chains. Connections shall be marked in accordance with the Standard Fire Prevention Code. Connection shall be UL listed and FM approved.
3. Fire Department connections shall be by Potter-Roemer, Powhatan, Elkhart or Reliable.

2.02 Materials (Below Ground)

- A. Piping: Ductile iron, UL listed Class 2 with standard cement lining and bituminous coatings, manufactured in accordance with ANSI A21.4 and A21.51. Pipe joints shall be standard mechanical joint or gasketed push-on joints equal to Tyton.
- B. Fittings: Ductile or cast iron, UL listed, 250 psi, with mechanical joints, cement lining and bituminous coating, manufactured in accordance with ANSI A21.10 and A21.11.
- C. Yard type fire hydrants shall be compression type, self draining, with two, 2-1/2-inch hose outlets and 4-1/2-inch pumper outlet with threads compatible to the local fire departments equipment. Valve opening and operating nut size shall be in accordance with local authority and insuring authority requirements. Hose outlets shall be equipped with caps and chains. Hydrant shall be UL-listed and AWWA or FM approved.
- D. Post indicator valves shall be UL-listed and FM approved, complete with valve and indicator post, operating wrench and break-a-way lock. Operating nut size and shape shall be in accordance with local and insuring authority requirements.

- E. Hydrants and outside valves shall be by Mueller, American Darling, or Clow.

Part 3 Execution

3.01 Installation

- A. Run pipe parallel to column center lines in a straight and true manner. Piping shall be installed at the highest elevation possible considering structure, equipment of other trades and insuring authority or NFPA 13 requirements.
- B. Install drains at all low points and make provisions to drain all parts of the systems according to NFPA standards.
- C. Piping for areas having finished ceilings shall be concealed above ceilings.
- D. Sprinklers in areas having a suspended lay-in ceiling, shall be centered in ceiling tile, without exception.
- E. Sprinkler head location shall be coordinated with ceiling grid, light fixtures and air diffusers to provide a symmetrical arrangement. Where sprinklers are within 12-inches of surface mounted lighting fixtures, 1-inch deep escutcheon plates shall be used for surface mounted pendant sprinklers.
- F. Provide all equipment and appurtenances necessary to complete the installation according to requirements of authorities previously named, whether indicated on the Drawings or not.

3.02 Installation (Below Ground)

- A. Underground services shall be installed in accordance with NFPA 13.
- B. All buried piping shall have not less than 42-inches cover.
- C. Coordinate installation of fire main backflow prevention as specified in Section 15405 and shown on the Drawings.
- D. Excavate the trench bottom around pipe joints so that the pipe rests on solid ground along its entire length.
- E. Rock, sand, unstable soil or other material unsuitable to bear pipe shall be excavated to a minimum depth of 6-inches below the bottom of the pipe and the space filled with gravel.
- F. After pipe has been tested, inspected and approved by the Engineer and all authorities having jurisdiction, all shoring materials shall be removed and the trench backfilled. Backfilling shall be done in layers not exceeding 8-inches. Moisten and tamp backfill to 95 percent maximum compaction (Standard Proctor density).

- G. Anchor underground pipe joints, tees, plugs, caps and valves with clamps, tie rods and concrete thrust blocks according to NFPA standards. Coat rods and clamps with asphalt to retard corrosion.
- H. Flush all underground piping in accordance with NFPA standards.
- I. Provide one-third of a cubic yard of crushed stone around base of each yard fire hydrant, for drainage.

3.03 Tests, Inspections and Identification

- A. Test all piping and alarm devices in accordance with the requirements of NFPA 13.
- B. All tests and inspections of the system and its components shall be witnessed by representatives of the Owner, the installer and the insurance and regulatory agencies at a time coordinated between all parties. A minimum of two days notice shall be given that the system is ready for tests. Test certificates shall be submitted upon completion of tests.
- C. Each portion of the system including underground portions shall be hydrostatically tested before piping is covered or concealed. Test shall be made with a pressure of 200 psig for two hours or 50 psig in excess of maximum system static pressure, whichever is greater.
- D. Inspection shall include operating test of all alarms, alarm valves and drains in conjunction with the fire alarm system.
- E. Signs or placards shall be permanently affixed to each riser at the alarm valve stating design criteria as required by NFPA 13.
- F. All sprinkler piping shall be primed and painted in red enamel taking care not to paint identification, gauges, information plates or sprinkler heads.
- G. All post indicator valves and fire department connections shall be identified with weatherproof, permanent signs identifying their corresponding service risers or areas.

END OF SECTION

Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to the provisions of Section 15050.
- B. Furnish, install, disinfect and test the water supply system as indicated on the Contract Documents.

1.02 References

- A. This specification references the latest edition of the publications listed below. Work shall be performed and materials shall be furnished in accordance with these publications as reference herein:

- 1. Kentucky State Plumbing Code
- 2. American National Standards Institute (ANSI)
 - A112.1.2 Air Gap Standards
 - B16.18 Cast Copper Alloy Solder-Joint Pressure Fittings
 - B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 - B16.26 Cast Copper Alloy Fittings for Flared Copper Tubes
- 3. American Society of Sanitary Engineering (ASSE)
 - 1003 Water Pressure Regulators and Reducing Valves for Domestic Water Supply Systems
 - 1012 Backflow Preventers with Intermediate Atmospheric Vent
 - 1013 Backflow Preventers, Reduced Pressure Principle
 - 1015 Backflow Preventers, Double Check Valve Assembly
- 4. American Society for Testing and Material (ASTM)
 - B 88 Seamless Copper Water Tube
 - D 1785 Polyvinyl chloride (PVC) Plastic Pipe and Fittings, Schedules 40, 80 and 120
 - D 2466 Polyvinyl chloride (PVC) Plastic Pipe Fittings, Schedule 40
 - D 2467 Socket Type Polyvinyl chloride (PVC) Plastic Pipe Fittings, Schedule 80

- D 2564 Solvent Cements for Polyvinyl chloride PVC Plastic Pipe and Fittings
- 5. American Water Works Association (AWWA)
 - C110 Gray-iron and Ductile-Iron Fittings, 3-inch through 48-inch for Water and other Liquids
 - C111 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe Fittings
 - C151 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
 - C506 Backflow Prevention Devices-Reduced Pressure Principle and Double Check Valve Types
 - C510 Standard for Double Check Valve Backflow Prevention Assembly
 - C511 Standard for Reduced Pressure Principle Backflow Prevention Assembly
 - C651 Standard for Disinfecting Water Mains
 - M14 Recommended Practice for Backflow Prevention and Cross-Connection Control
- 6. Foundation of Cross-Connection Control and Hydraulic Research (FCCC-HR), University of Southern California - Section 10 Manual of Cross-Connection Control
- 7. Plumbing and Drainage Institute (P&DI)
 - WH-201 Certification, Sizing, Placement of Water Hammer Arrestors.

1.03 Submittals

- A. Submit product data in accordance with Sections 01340 and 15050.
- B. Submit product data on all products proposed for installation under this Section, including but not limited to the following:
 - 1. Pipe and fittings.
 - 2. Valves.
 - 3. Pressure reducing valves.

4. Pressure control valves.
 5. Backflow preventers.
 6. Thermostatic Mixing Valves.
 7. Water hammer arresters.
- C. Submit installation and maintenance instructions and spare parts lists in accordance with Sections 01730 and 15050.

1.04 Quality Assurance

- A. Work shall be performed by workers skilled in the installation of domestic water systems.
- B. Installation, disinfection and testing shall be supervised by a master plumber licensed in the State of Kentucky who shall be responsible for the installation of the entire system in accordance with the Kentucky State Plumbing Code.

Part 2 Products

2.01 Pipe and Fittings (Below Ground)

- A. Ductile Iron, Cement-Mortar Lined Piping
1. Pipe: AWWA C151 with mechanical or push-on joints conforming to AWWA C111.
 2. Fittings: AWWA C110, not less than Class 150, with mechanical joints.
- B. Copper Tubing
1. Tube: ASTM B 88, Type K, hard drawn unless noted otherwise.
 2. Fittings: Either flared cast bronze, solder-wrought copper or bronze; ANSI B16.22 and B16.26, except that unions shall be either brass or bronze and either threaded or soldered.

2.02 Pipe and Fittings (Above Ground)

- A. Copper Tubing
1. ASTM B 88, Type L, hard drawn unless noted otherwise.
 2. Fittings: Solder type, either cast bronze conforming to ANSI B16.18 or wrought copper or bronze conforming to ANSI B16.22, except that unions shall conform to FS WW-U-516 and be either brass or bronze and either threaded or

soldered.

B. Copper Alloy Tubing

1. Tube: Heavy type conforming to ASTM B 543, Alloy 194.
2. Fittings: Solder type, either cast bronze conforming to ANSI B16.18 or wrought copper or bronze conforming to ANSI B16.22, except that unions shall conform to FS WW-U-516 and be either brass or bronze and either threaded or soldered.

C. CPVC Piping

1. Pipe and Fittings 2-inches and smaller: Provide physical dimensions, test requirements and workmanship for copper tube size (CTS) piping system conforming to the requirements of ASTM D 2846.
2. Solvent Cement: ASTM F 493.
3. Piping system shall be rated for a maintained temperature of 180 degrees F at a pressure of 100 psig.

2.03 Joints and Jointing Materials

- A. Flanges for ends of pipe and fittings shall be cast iron and conform to AWWA C110, except that pipe flanges shall be screw-on type having threads conforming to ANSI B16.1 for 125 pound Class. Bolts, nuts and gaskets shall conform to AWWA C111. Gaskets shall be plain rubber, 1/8-inch thick.
- B. Fittings immediately inside exterior wall and fittings that unite dissimilar metals shall be dielectric insulating type.

2.04 Valves

- A. Smaller than 3-inches shall be threaded or soldered, 3-inches and larger shall be flanged.
- B. Gate Valves
 1. Smaller than 3-inches shall be Class 125, Type III, rated for a hydraulic working pressure of 125 psi.
 2. 3-inches and larger shall be Class 125, Type II, outside-screw-and yoke type; rated for a hydraulic working pressure of 125 psi.
- C. Check Valves - Metallic
 1. Smaller than 3-inches shall have bronze trim and either cast iron or steel body, and be rated for a hydraulic working pressure of 125 psi.

2. 3-inches and larger shall be weight-loaded, have bronze trim and either cast iron or steel body and be rated for a hydraulic working pressure of 125 psi.
 - a. Buried Lines: Mechanical joints.
 - b. In Valve Chambers, Valve Pits and Above Ground: Flanged joints.

D. Check Valve (Plastic)

1. Check valves, ½-inch to 4" diameter, shall be of industrial grade construction with minimum turbulence, CPVC body, standard O-ring seat, and fully serviceable and replaceable components. Sizes ½" to 2" shall be pressure rated for 235 PSI and 2-1/2" to 4" shall be pressure rated for 150 PSI. Valves shall be NSF certified for potable water use. Valves shall be equal to True Union 2000 Industrial as manufactured by Spears Manufacturing Company.

E. Ball Valves - Metallic

1. Smaller than 3-inches shall be bronze body with full port, rated for a hydraulic working pressure of 150 psi.
2. 3-inches and larger shall be carbon steel or stainless steel body, stainless steel trim with full port, rated for a hydraulic working pressure of 150 psi.

F. Ball Valves – Thermoplastic

Ball valves, ½-inch to 6-inch diameter, shall have CPVC body with full port, EPDM O-ring stem seal and Teflon ball seat. O-ring seals shall be EPDM. Valves shall withstand 150 psig non-shock pressure. Valves shall have true union connections at each end. Valves shall be NSF certified for potable water use. Valves shall be equal to type True Union 2000 Industrial as manufactured by Spears Manufacturing Company.

G. Globe Valves

1. Globe valves 2-inches and smaller shall be bronze body with rising stem, screwed bonnet, integral bronze seat, renewable PTFE discs with screwed or solder joint ends. Valve shall be rated for a non-shock cold working pressure of 300 psi.
2. Globe valves 2-1/2-inches and larger shall be iron body, Class 125, flanged ends with bolted bonnet and non-rising stem. Valves shall be rated for a hydraulic working pressure of 150 psi.

H. Acceptable Manufacturers: Crane, Nibco, Stockham, Milwaukee, Watts, Apollo, Kitz.

2.05 Pressure Reducing Valves (1/2 to 2-Inch Size)

- A. Provide bronze body, spring controlled, adjustable pressure reducing valve with

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threaded connections.

- B. Provide valves with high temperature diaphragm and renewable nickel alloy seat.
- C. Provide with thermal expansion bypass.
- D. Provide with separate bronze strainer with 20 mesh stainless steel basket. Attach to valve with bronze nipple.
- E. Rated for 300 psig maximum inlet water pressure with adjustable 25-75 psig outlet water pressure.
- F. Tested and certified under ASSE 1003 and the Kentucky State Plumbing Code.
- G. Acceptable Manufacturers: Watts 223SB, Wilkins, Mueller.

2.06 Backflow Preventers, Reduced Pressure Zone Type (RPZ) (3/4 to 2-Inch Size)

- A. Provide reduced pressure zone backflow preventers where noted on the Drawings. Backflow preventers shall be rated for operation with inlet water pressures up to 175 psig and water temperatures up to 140-1/2 degrees F. Backflow preventers shall be tested and certified in accordance with ASSE 1013 and AWWA C506 and USC-FCCCHR.
- B. Provide with bronze body construction, rubber check valve and relief valve assemblies, and Clecon check seats.
- C. Provide isolation valves on the inlet and outlet of each backflow preventer for maintenance. These valves shall be quarter turn, full port, resilient seated, bronze ball valves.
- D. Provide bronze ball body valve test cocks.
- E. Provide bronze body strainer on the inlet of each backflow preventer.
- F. Acceptable Manufacturers: Watts Series 909, Wilkins, Hersey.

2.07 Backflow Preventers, Double Check Valve Type (DCV) (2-1/2 to 10-Inch Size)

- A. Provide double check valve backflow preventers where noted on the Drawings. Backflow preventers shall be rated for operation with inlet water pressures up to 175 psig and water temperatures up to 110-1/2 degrees F. Backflow preventers shall be tested and certified in accordance with ASSE 1015 and AWWA C506.
- B. Provide with FDA approved epoxy coated cast iron check valve bodies, removable bronze seats, and stainless steel internal parts.

- C. Valves shall be accessible with top or side access for maintenance without requiring removal from the line.
- D. Provide isolation valves on the inlet and outlet of each backflow preventer. These valves shall be OS&Y gate valves.
- E. Provide bronze body ball valve test cocks.
- F. Provide FDA approved epoxy coated cast iron body strainer on the inlet of each backflow preventer or as otherwise noted.
- G. Acceptable Manufacturers: Watts Series 709, Wilkins, Hersey.

2.08 Thermostatic Mixing Valve

- A. Thermostatic mixing valve shall conform to the requirements ANSI Z358.1 - 2004 for hot water temperature control.
- B. Valve shall have a brass body and shall include integral check valves and an adjustment cap with locking feature.
- C. The valve shall have a dial thermometer.
- D. Valve shall be Bradley Model S19-2100 EFX25 or equal by Simmons, PPP Inc. or Leonard.

2.09 Water Hammer Arresters

- A. Permanently packaged water hammer arrester with bellows, diaphragm or O-ring/disc sealing mechanism.
- B. Provide in accordance with PDI Standard WH-201.
- C. Acceptable Manufacturers: Sioux Chief Hydra-Rester, Zurn, Josam.

2.10 Piping Accessories

- A. Nipples: FS WW-N-351; be of same type material as piping on which installed.
- B. Unions for Copper Tubing: Brass or bronze, have either threaded or solder joint ends and conform to FS WW-U-516.
- C. Unions for Steel Piping: FS WW-U-531.
- D. Escutcheons: Polished chromium-plated pressed steel, split-hinged, locking type held in-place by either an internal tension spring or a set-screw; encompass sleeve or opening.

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- E. Bolts and Nuts: Machined brass, stainless steel or galvanized carbon steel, and not smaller than 1/4-inch; bolts shall have hexagonal heads and nuts shall be hexagonal.
- F. Solder for Solder-Jointed Tubing: 95 percent tin and five percent antimony. Flux shall be non-corrosive type conforming to NSF 61.
- G. Strainers
 - 1. Strainers in water lines shall have standard pattern, stainless steel baskets with standard perforations. Bodies shall be bronze for sizes 2-inch and smaller and cast iron for sizes 2-1/2-inch and larger. Strainers shall be equal to Watts Series 77 unless otherwise specified in other sections of Division 15.
 - 2. All strainers shall be of the same size as the piping in which they are installed. Provide dielectric union, if necessary, to isolate strainer from pipe material.

2.11 Trap Primer

- A. Provide brass trap primer that automatically supplies water to P-traps upon 5 psi or less pressure drop in water line.
- B. Install trap primer, distribution unit(s) and water lines per manufacturer's recommendations.
- C. Acceptable Manufacturer's: Equal to Precision Plumbing Products.

Part 3 Execution

3.01 Installation

- A. Install water systems in accordance with AWWA standards and local codes applicable to water system installation.
- B. Earthwork and trenching shall be in accordance with Section 02225 of these Specifications.
- C. Cut pipe and tubing accurately to measurements established at worksite; work pipe into place without springing and forcing. Install pipe with a fall towards either shut-off valve or lowest fixture.
- D. Cut ends of copper tubing square, and remove burrs. Clean ends of tubing and apply a rosin type flux to outside surface of tubing ends and on recess inside of fittings. Insert tubing to full depth of fitting; then solder-joints before soldering valves.
- E. Install piping true to line and grade and support and guide in a manner which will ensure indicated alignment. Installed piping shall clear obstructions, preserve headroom, keep openings and passageways clear, and not be in same trenches as sewer lines. Water supply system drawings are schematic; do not scale. Install unions on pipe ends immediately adjacent to valves, equipment and tanks.

- F. Valves shall be accessible for operation and servicing. Stems of installed valves shall not be below horizontal position. Valves which will be in furred spaces shall be accessible.
- G. Make-up soldered-to-threaded connections with male thread-to-solder adapters.
- H. After pipes have been installed, either cap or plug ends of pipes. Neither bury, furr-in, nor conceal piping before piping has been inspected and tested.
- I. Provide access panels in finished walls for access to concealed valves, water hammer arrestors and other devices requiring periodic maintenance.
- J. Install insulation in accordance with Section 15250 of these Specifications.
- K. Install backflow preventers in accordance with the manufacturer's directions and AWWA M14.
- L. Dielectric Isolation
 - 1. Wherever copper, brass or bronze piping systems are connected to steel or iron piping systems, this connection shall be made with dielectric isolators. The dielectric isolators shall be so designed that non-ferrous piping materials shall be isolated by the use of Teflon or nylon isolating materials made up in the form of screwed type unions or insulating gaskets and bolt sleeves and washers for standard flanged connection. All dielectric isolators shall be selected for the pressure of the system involved.
 - 2. Dielectric isolators shall be Watts, Epco, Crane or Maloney.
- M. See Section 15069 for installation of PVC and CPVC piping and fittings.

3.02 Testing

- A. Test installed building water supply system in accordance with the Kentucky State Plumbing Code.
- B. Test piping that will be buried and concealed prior to concealment.

3.03 Disinfecting

- A. Disinfect water systems in accordance with AWWA C651 and local codes applicable to water system disinfecting.
- B. Before disinfecting system, flush line in a manner which will remove all extraneous materials.
- C. Disinfect each section of new line before seeking acceptance of water supply system.

- D. Either directly apply chlorine or mix water and either calcium hypochlorite, chlorine gas, or calcium chloride. Retain solution in pipe for not less than 24 hours, then measure residual chlorine at ends of section and at other representative points; residual chlorine content is similar to that obtained from source.

END OF SECTION

Part 1 General**1.01 Scope**

- A. Work specified in this Section is subject to the provisions of Section 15050.
- B. Furnish, install and test the sanitary sewer system as indicated on the Contract Documents. Do not scale drawings.

1.02 References

- A. This specification references the latest edition of the publications listed below. Work shall be performed and materials shall be furnished in accordance with these publications as reference herein:

- 1. Kentucky State Plumbing Code
- 2. American National Standards Institute (ANSI)
 - B16.1 Cast Iron Pipe Flanges and Flanged Fittings Class 25,125, 250 and 800
 - B16.12 Cast Iron Threaded Drainage Fittings
 - B16.23 Cast Copper Alloy Solder Joint Drainage Fittings-DWV
- 3. American Society for Testing and Materials (ASTM)
 - A 48 Gray Iron Castings
 - A 74 Cast Iron Soil Pipe and Fittings
 - A 395 Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
 - A 888 Hubless Cast Iron Soil Pipe and Fittings
 - B 306 Copper Drainage Tube-DWV
 - C 564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings
 - D 2146 Polypropylene Molding and Extrusion Materials
 - D 2665 Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe, Schedules 40 and 80
 - D 2665 or F 441 Fittings: Solvent Weld Socket Type, Same Schedule as Piping
 - D 2665 or F 439

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- F 493 Solvent Cement
- 4. American Water Works Association (AWWA)
 - C110 Gray-Iron and Ductile-Iron Fittings, 3-inches through 48-inches, for Water and other Liquids
 - C112 2-inch and 2-1/2-inch Cast Iron Pipe, Centrifugally Cast, for Water or other Liquids
 - C302 Reinforced-Concrete Water Pipe - Noncylinder Type, Not Prestressed
- 5. Cast Iron Soil Pipe Institute (CISPI)
 - 301 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- 6. Federal Specifications (FS)
 - WW-P-421D Pipe, Cast Gray and Ductile Iron, Pressure (For Water and Other Liquids)
 - WW-P-541E Plumbing Fixtures (General Specification)
- 7. National Bureau of Standards (NBS)
 - Handbook H28
- 8. Underwriters Laboratories, Inc. (UL) Standards
 - UL 58 Steel Underground Tanks for Flammable and Combustible Liquids
 - UL 971 Listed Non-Metal Pipe
 - UL 1316 Glass Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products

1.03 Submittals

- A. Submit product data in accordance with Sections 01340 and 15050.
- B. Submit product data on all products proposed for installation under this Section, including but not limited to the following:
 - 1. Pipe and fittings.
 - 2. Drains.

3. Cleanouts.

C. Submit installation and maintenance instructions and spare parts lists.

1.04 Quality Assurance

A. Work shall be performed by workers skilled in the installation of sanitary drainage systems.

B. Installation and testing shall be supervised by a master plumber licensed in the State of Kentucky who shall be responsible for the installation of the entire system in accordance with the Kentucky State Plumbing Code.

C. Installation tools and equipment shall not damage products.

1.05 Jobsite Conditions

Coordinate installation with other building systems in a manner which will preclude interferences.

Part 2 Products

2.01 Polyvinyl Chloride (PVC) DWV PIPE

A. PVC Pipe and Fittings, 2 to 8-inch diameter, concealed, exposed, or buried:

1. Pipe in accordance with ASTM D 2665.
2. Fittings: Molded fittings in accordance with ASTM F 1866.
3. Solvent Cement: ASTM D 2564.

B. PVC Pipe and Fittings, 10 to 20-inch diameter, buried or concealed:

1. Schedule 40 pipe in accordance with ASTM 1785.
2. Fittings: Solvent weld socket type, DWV pattern, same schedule as piping, in accordance with ASTM F 1866.
3. Solvent Cement: ASTM D 2564.

C. PVC Pipe and Fittings, 10 to 20-inch diameter, exposed:

1. Schedule 80 pipe in accordance with ASTM D 1785.
2. Fittings: Solvent weld socket type, DWV pattern, same schedule as piping, ASTM F 1866.

3. Solvent Cement: ASTM D 2564.

2.02 Drains

A. Floor Drain (FD-1)

1. Lacquered cast iron body, integral flange and double drainage weepholes with push-on joint outlet connection and 1/2-inch trap primer connection.
2. Adjustable 6-inch diameter satin nickel bronze strainer with 1/2-inch thick grate with a free area of at least 9.5 square inches.
3. Floor drains shall be Josam 30000-A-Y, Smith, Wade, Zurn, or Ancon.

B. Floor Drain (FD-2)

1. Coated cast iron with double drainage flange, weepholes, bottom outlet, heavy-duty loose-set special duty grate.
2. Floor drain shall be Josam Series 31720-Y, Smith, Wade, or Zurn.
3. Furnish with a trap primer connection and push-on pipe connection.

C. Air Gaps

1. Coated cast iron with integrally cast air ports, female threaded inlet and outlet.
2. Air gap shall be Josam Series 88910, Smith or Zurn.

D. Hub Drain (HD-1)

1. Provide single pipe hub drain where shown on the Drawings.
2. Provide with lacquered cast iron body, integral flange, double drainage weepholes, and adjustable satin nickel bronze hub.
3. Provide with trap primer tapping and push-on pipe connection.
4. Hub drains shall be Josam 30000-E2, Smith, Wade, Zurn, or Ancon.

2.03 Cleanouts

- A. Cleanout bodies shall be cast iron conforming to ASTM A 74.
- B. Floor Cleanouts (FCO): Adjustable, with bronze tapped plug, scoriated nickel-bronze cover and, if for membraned floors, a clamping device.
- C. Wall Cleanouts (WCO): Bronze tapped plug, cover shall be polished stainless steel, in flanged frame secured to plug with vandal-proof screw.

- D. Exposed Cleanouts: Have tapered caulking ferrule and raised brass head cleanout plug.
- E. Exterior Cleanouts (YCO): Have adjustable sleeve-type housing, countersunk threaded brass plug and cast iron frame and cover.
- F. Cleanout plugs shall not be larger than 4-inches. Cleanouts for CPVC pipe shall consist of a longsweep 1/4 bend or one or two 1/8 bends extended to the place indicated; other cleanouts shall be T-pattern, 90-degree branch drainage fittings having screw plugs.
- G. Cleanouts shall be manufactured by Josam, Smith, Wade, Zurn, or Ancon.

2.04 Piping Specialties

- A. Gaskets for Flanged Joints: Full-face, either neoprene, asbestos, or rubber; rubber gaskets: AWWA C302.
- B. Vent Caps for Service Weight Soil Pipe: ASTM A 74.
- C. Gaskets, Glands and Bolts for Mechanical Joint Pipe and Fittings: AWWA C110, AWWA C112 and FS WW-P-421C.
- D. Unions for Ferrous Pipe 3-Inches in Diameter and Smaller: 150 pound steam-working-pressure zinc-coated malleable iron ground-joint type.
- E. Unions for Ferrous Pipe 3-1/2-Inches in Diameter and Larger: 125 pound steam-working-pressure forged steel flange type, having cloth-inserted rubber gaskets 1/16-inch thick.
- F. Couplings for Joining Hubless Cast Iron Pipe and Fittings: Cast iron housing conforming to ASTM A 48, Class 30A, have bitumastic coating, neoprene gasket conforming to ASTM C 564 and 18-8 stainless steel bolts and nuts.
- G. Solder for Solder-Jointed Tubing: 95 percent tin and five percent antimony; flux shall be non-corrosive.
- H. Joint in Sanitary Lines Immediately Inside Exterior Wall and Joint Between Pipe of Dissimilar Metal: Dielectric insulating joint, union or coupling.
- I. Threaded joints shall have ANSI taper pipe threads conforming to NBS Handbook H.
- J. Joint Compound: Either graphite, inert filler and oil or polytetra-fluoroethylene tape.
- K. Joints in cast iron soil pipe and fittings having a double seal, compression-type molded neoprene gasket shall have a modified hub to provide a positive seal.

2.05 Flashing

Either soft-temper or cold-rolled copper weighting not less than 16 ounces per square foot or sheet lead weighting not less than four pounds per square foot.

2.06 Traps

"P" type, unless otherwise indicated; ASTM A 74. Traps for steel pipe and copper tubes shall have either recess drainage pattern or brass tube not less than 17 gauge. Traps for PVC piping shall conform to ASTM D 2665 and shall be approved by NSF or IAPMO.

2.07 Escutcheon

Polished chromium-plated pressed steel, split-hinged, locking type held in place by either an internal tension spring or a set-screw and encompass sleeve or opening.

Part 3 Execution

3.01 Installation

- A. Horizontal soil and waste pipe grades shall not be less than 1/4-inch per foot for 2-1/2-inch size and smaller, and not be less than 1/8-inch per foot for 3-inch size and larger.
- B. Changes of soil, waste, and drain pipe sizes shall be made with reducing fittings. Changes in direction shall be with either 45 degree wyes; long or short-sweep 1/4, 1/6, 1/8, or 1/16 bends; or elbows.
- C. Install trap at each fixture and piece of equipment connecting to the sanitary sewer system. Place trap as near fixture and equipment as possible; do not double-trap fixture.
- D. Slip joints will be permitted only in trap seals or on inlet side of traps. Union connections shall be made with either tucker or hub drainage fittings.
- E. Install and connect products in accordance with product manufacturer's printed installation instructions. Apply joint compound to threaded joints and tighten joints to a degree which will prevent leaks.
- F. Interior of pipe, pipe fittings, drains and cleanouts shall be clean before being installed and foreign substances on interior surfaces shall have been removed.
- G. Cut ends of copper tube square and remove burrs. Clean outside of tube, where tube engages fittings and inside of fitting contacting tube, with an abrasive material before soldering. Tube and fittings shall not be annealed when making connections. Core solder will not be permitted. Apply heat uniformly around tube and fitting joints in

copper tube 2-1/2-inches and larger; use multiflame torch.

- H. Join sections of hubless pipe with cast iron assemblies. Tighten threaded assemblies to 60 inch-pounds torque on each joint with a torque wrench specifically designed for the purpose. Retorque each screw not less than 24 hours after initial tightening.
- I. Extend main vertical soil and waste stacks full size to roofline and above as vents, except where otherwise specifically indicated. Install vent pipes in roof spaces as close as possible to roof underside without forming traps in pipes; use fittings as required. If a circuit vent pipe from fixture, or line of fixtures, will be connected to a vent line serving other fixtures, connect at least 6-inches above floor level rim of highest fixture served. Grade vent and branch-vent pipe in a manner which will ensure that condensate will drain to vertical stack.
- J. Surfaces and structures to, and on, which sewer products will be affixed, placed and erected shall be capable of supporting those products.
- K. Set pipe and fittings to line and grade before making-up joints
- L. Angular deflection of joints shall not exceed the recommendations of the pipe and fitting manufacturer. Should alignment require deflections to exceed those recommended, achieve indicated deflection with either special bends or short lengths of pipe.
- M. Products to be buried shall rest on excavation bottom; recess lower quadrant of pipe and fittings, and ends thereof; into excavation bottom. Bells shall face upstream. Space between inside of bells and outside of spigots shall be even all around. Ring joints shall be made-up only after retaining groove has been cleaned and only after ring and groove have been lubricated.
- N. Excavations shall be free from water and extraneous material immediately before sewer products to be buried are placed therein. Bottoms of trenches shall have been shaped to support bottom quadrant of pipe and fittings and ends thereof. Should rock and material unsuitable to support product exist at design elevation, excavate 8-inches below design elevation and backfill additionally excavated space with sand.
- O. Secure products not to be buried to hangers, supports and anchors. Tighten bolts and nuts of flanged joints to a degree which will prevent leaks.
- P. Seal open ends of products at end of work period and in a manner which will prevent water and foreign material from entering; remove seals when work resumes.
- Q. Install escutcheons where exposed piping, bare or insulated, passes through floors, walls and ceilings. Fasten escutcheons to pipe or pipe covering.
- R. Pipe sleeves for pipes passing under footings or through foundation walls shall be Schedule 40 ductile iron pipe extending one foot beyond either face of the footing or wall.

- S. Solvent-Welded PVC Joints: All solvent-welded PVC joints shall be installed in accordance with ASTM 2855.

3.02 Floor Drain Installation

- A. Coordinate floor drain locations and installation elevations with the Structural and Architectural Drawings.
- B. Install floor drains at the local low point in the floor slab.
- C. Install floor drains with membrane clamping rings if the floor slab contains a membrane.
- D. Protect the floor drain during the floor slab pour to prevent extraneous material from entering the drain or waste piping. Cover during the remainder of the construction to prevent blockage with construction debris.

3.03 Cleanout Installation

- A. Install cleanout tee with screw plug on each building drain.
- B. Install outside cleanouts at grade centered in an 18 x 18 x 4-inch thick concrete pad. Top of pad shall be at grade elevation unless otherwise noted.

3.04 Inspection and Testing

- A. Test installed sanitary drainage and building sewer systems with water and air in accordance with the Kentucky State Plumbing Code.
- B. If system exhibits leaks, repair leaks and retest system until system exhibits no leaks.
- C. Test piping that will be buried and concealed prior to concealment.

3.05 Cleaning

- A. Remove foreign material from product surfaces, but do not remove manufacturers' labels until Project has been accepted by the Engineer, then remove labels.
- B. Repair pipe coating that may have been damaged during pipe installation.

END OF SECTION

Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to the provisions of Section 15050.
- B. Furnish, install and test plumbing fixtures as indicated in the Contract Documents.

1.02 References

- A. This specification references the latest edition of the publications listed below. Work shall be performed and materials shall be furnished in accordance with these publications as reference herein:

- 1. Kentucky State Plumbing Code
- 2. American National Standards Institute (ANSI)
 - A112.6.1M Supports for Off-the-Floor Plumbing Fixtures for Public Use
 - A117.1 Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People
- 3. Federal Specifications (FS)
 - WW-P-541/1E Plumbing Fixtures (Water Closets)
 - WW-P-541/2E Plumbing Fixtures (Urinals)
 - WW-P-541/4E Plumbing Fixtures (Lavatories)
 - WW-P-541/6E Plumbing Fixtures (Drinking Fountains)
 - WW-P-541/7C Plumbing fixtures (Shower Bath and Emergency Eye and Face Wash Outfits)

1.03 Submittals

- A. Submit product data in accordance with the applicable requirements of Sections 01340 and 15050.
- B. Submittal data shall include catalog cuts for fixtures and all accessories. Product data shall completely describe all features and materials of construction.
- C. Submit service and maintenance manuals and spare parts lists for all fixtures.

1.04 Quality Assurance

- A. Inspect surfaces and structures to, and on, which plumbing fixtures will be affixed, placed, and installed before starting the work of this Section; surfaces shall be capable of supporting fixtures.
- B. Surfaces which will be concealed by plumbing fixtures shall have been finished before fixtures are installed.
- C. Inspect fixtures before installing.

Part 2 Products

2.01 Water Closets

- A. Floor Mount Flush Valve Water Closet (WC-1)
 - 1. Provide floor mounted, floor outlet, vitreous china, low consumption water closet, standard height.
 - 2. Provide with elongated, siphon-jet closet bowl with 1-1/2-inch top spud.
 - 3. Provide with open front, elongated solid plastic seat, Bemis, Beneke, Kohler or Olsonite.
 - 4. Provide with exposed flush valve, Sloan Royal 111 (1.6 gallon flush) or equal by Delany or Zurn.
 - 5. Water closets shall be American Standard 2234.015 or equal by Eljer or Kohler.

2.02 Lavatories

- A. Wall-Hung Lavatory (LAV-1)
 - 1. Provide wall mounted, 20 x 18-inch vitreous china lavatory, punched for 4-inch centerset faucets, with faucet ledge and backsplash.
 - 2. Provide with single lever centerset lavatory fitting on 4-inch centers with chrome plated brass handle, aerator with 2.0 gpm flow restrictor, pop-up waste with stopper and 1-1/4-inch O.D. tailpiece. Faucet shall be American Standard Reliant 2385.278 or equal by Eljer, Kohler, Delta, or Moen.
 - 3. Provide with 1-1/4 x 1-1/4-inch 17 gauge chrome plated cast brass adjustable P-trap with cleanout, slip joint inlet and tubing outlet with wall flange.
 - 4. Provide with 3/8-inch chrome plated brass wall supplies with wall flanges and wheel handle stops.

5. Lavatory shall be American Standard Lucerne 0355.012 or equal by Eljer or Kohler.

B. Floor Mounted Service Sink (SSK-1)

1. Provide 28 x 18 x 13-inch acid resisting, enameled cast iron corner service sink.
2. Provide with exposed service sink faucet with top brace, bucket hook, vacuum breaker, lever handles, hose end, 1/2-inch NPT adjustable inlets and integral stops. Faucet shall be American Standard 8344.112 or equal by Eljer or Kohler.
3. Provide drain with strainer and socket for 3-inch outlet.
4. Sink shall be American Standard Florwell 7741.000, or equal by Eljer or Kohler.

2.03 Emergency Fixtures

A. Drench Shower/Eyewash (ESH-1)

1. Provide combination drench shower/eyewash units with 10-inch diameter impact-resistant plastic shower, 10-inch diameter impact-resistant plastic eyewash bowl, separate shower and eyewash stay-open valves, 1-1/4 IPS supply inlet and drain, and floor flange.
2. Provide with identification sign designed for wall mounting to read "EMERGENCY SHOWER AND EYE WASH FOUNTAIN".
3. Shower/eyewash shall be Bradley S19-310, or equal by Haws or Speakman.

B. Safety Shower/Eyewash (ESH-2)

1. Provide freezeproof combination drench shower/eyewash units with 10-inch diameter impact-resistant plastic shower, no eyewash bowl, stay-open valves, 1-1/4 IPS supply inlet and drain through the wall design.
2. Provide with identification sign designed for wall mounting to read "EMERGENCY SHOWER AND EYEWASH FOUNTAIN".
3. Shower/eyewash shall be Bradley S19-310TW or equal by Haws or Speakman.

C. Non-Freeze Wall Hydrant (NFWH-1)

1. Provide 1-inch size non-freeze wall hydrant, cast bronze construction, with integral vacuum breaker-backflow preventer and 1-inch hose thread outlet.
2. Wall hydrant shall be Josam 71050, or equal by Jonespec, or J. R. Smith.

Part 3 Execution

3.01 Installation

- A. Install plumbing fixtures in accordance with the manufacturer's installation instructions.
- B. Install wall hung fixtures with heavy-duty carriers of the model and type recommended by the manufacturer.
- C. Caulk and seal around installed fixtures for a neat, finished appearance; coordinate with architectural finishes and cabinetry related to the plumbing fixtures.
- D. Install fixtures in accordance with all requirements of the Kentucky State Plumbing Code.
- E. Install handicap fixtures in accordance with all requirements of ANSI A117.1 and ADA guidelines.
- F. Insulate all exposed hot water and drain piping below handicap lavatories and sinks, or configure hot water and drain piping to protect against contact.

3.02 Demonstration

- A. Test plumbing fixtures for proper operation and adjustments of valves, levels, etc.
- B. Inspect plumbing connections to fixtures for leaks or damage. Repair as required.

END OF SECTION

Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to the provisions of Section 15050.
- B. Furnish and install plumbing equipment of the type specified below and scheduled on the Drawings.

1.02 References

- A. The latest edition of the publications listed below are included as part of these Contract Documents:
 - 1. Kentucky State Plumbing Code
 - 2. ANSI/ASME Section 8D - Pressure Vessels
 - 3. ANSI/NFPA 70 - National Electrical Code
 - 4. ANSI/UL 1453 - Electric Booster and Commercial Storage Tank Water Heaters
 - 5. Underwriters Laboratories, Inc. (UL) - UL Listing and Label

1.03 Submittals

- A. Submit shop drawings and product data under provisions of Sections 01340 and 15050.
- B. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
- C. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings and drains.
- D. Submit manufacturer's installation instructions under provisions of Sections 01340 and 15050.
- E. Submit manufacturer's certificate that pressure vessels meet or exceed specified requirements.
- F. Include operation, maintenance and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- G. Submit pump curves, dimensional diagrams and wiring diagrams for pressure booster systems.

1.04 Quality Assurance

- A. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
 - 1. American Society of Mechanical Engineers (ASME)
 - 2. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI)
 - 3. National Electrical Manufacturers' Association (NEMA)
 - 4. Underwriters Laboratories (UL)
- B. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.05 Delivery, Storage and Handling

- A. Deliver products to site in undamaged condition by means consistent with the materials provided.
- B. Store and protect products from damage until installed on the job.
- C. Provide temporary protection caps on all piping connection nozzles. Maintain caps in place until installation of piping.

1.06 Warranty

- A. Warranties shall include complete coverage of labor and material charges for repair of covered equipment and shall be in accordance with Section 01740 except as described herein.
- B. Provide five year manufacturer's warranty for coverage of domestic water heaters and pumps.

Part 2 Products

2.01 Electric Water Heaters

- A. Factory assembled and wired, electric water heater, energy efficient per ASHRAE standards, 125 psig maximum working pressure and ASME rated temperature and pressure relief valve.
- B. Welded steel pressure vessel; glass lining, insulated tank; enclosed with steel jacket; baked enamel finish.

- C. Temperature controls include high temperature limit control and limiting switch (requiring manual reset in the event temperature reaches 190 degrees F.
- D. Flange mounted immersion heating electrical elements; individual elements sheathed with Incoloy corrosion- resistant metal alloy (element fusing per NEC), and anode rod for corrosion protection.
- E. Water heaters shall be manufactured by Lochinvar, A.O. Smith, or State.

2.02 Hot Water Storage Tank

- A. Jacketed and insulated ASME storage tank with enclosed high density fiberglass insulation of sufficient thickness to meet requirements of ASHRAE 90.1b-1999 standard. Tank shall be constructed and stamped according to ASME specifications for 125 psi working pressure. The tank shall be constructed of carbon steel and shall be lined with glass. Tank shall be equipped with the number and size of magnesium anode rods sufficient to provide adequate cathodic protection for the tank lining. Tank shall be of vertical design. The tank cabinet shall be of heavy gauge steel with high quality powder coat paint.
- B. Tank shall be Model PVG 02000 OVTA125 as manufactured by State Water Heaters or equal by Lochinvar or PVI Ind.

2.03 In-Line Circulator Pumps

- A. Casing: Bronze, rated for 125 psig working pressure.
- B. Impeller: Bronze.
- C. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- D. Seal: Carbon rotating against a stationary ceramic seat.
- E. Drive: Flexible coupling.
- F. Pumps shall be manufactured by Bell and Gossett, Armstrong, or Taco.

Part 3 Execution

3.01 Water Heater Installation

- A. Install water heaters in accordance with manufacturer's instructions and to UL requirements.
- B. Coordinate with plumbing piping and related electrical work to achieve operating system.

3.02 Pump Installation

- A. Install in accordance with manufacturer's instructions.
- B. Provide line sized gate valve and strainer on suction and line sized soft seated check valve and gate valve on discharge of, or other valving arrangements as indicated on the Drawings.
- C. Decrease from line size, with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings.
- D. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

3.03 Demonstration

- A. Adjust water temperature setpoint to setting desired by the Owner.
- B. Demonstrate proper operation of the water heaters to maintain the setpoint temperature, including all safety devices, prior to acceptance.
- C. The pressure booster system manufacturer's representative shall provide system start-up and instruction to the Owner's designated personnel on operation and maintenance.

END OF SECTION

Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to the provisions of Section 15050.
- B. Furnish and install natural gas distribution piping, pressure regulating valves, shutoff valves, safety devices and other items required for a complete system.

1.02 References

- A. This specification references the latest edition of the publications listed below. Work shall be performed and materials shall be furnished in accordance with these publications as reference herein:

- 1. Kentucky State Building Code
- 2. National Fire Protection Association (NFPA) Standards
 - NFPA 54 National Fuel Gas Code
 - NFPA 70 National Electrical Code
- 3. American Society for Testing and Materials (ASTM) Standards
 - ASTM A 53 Pipe, Steel, Black and Hot-dipped, Zinc-coated, Welded and Seamless
 - ASTM A 106 Seamless Carbon Steel Pipe for High Temperature Service
 - ASTM B 88 Specification for Seamless Copper Water Tube
 - ASTM B 197 Cupola Malleable Iron
 - ASTM B 280 Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
 - ASTM D 2513 Specification for Thermoplastic Gas Pressure Piping Systems
 - ASTM D 2517 Specification for Reinforced Epoxy Resin Gas Pressure Pipe and Fittings
- 4. American National Standards Institute (ANSI)
 - Z21.15 Manually Operated Gas Valves
 - Z21.18 Gas Appliance Regulators
 - Z21.21 Automatic Valves for Gas Appliances

1.03 Submittals

- A. Manufacturers' data, shop drawings and catalog cuts shall be submitted for all components and materials in accordance with Sections 01340 and 15050.
- B. The Contractor shall obtain approval and permits from the authority having jurisdiction for the proposed installation prior to submitting to the Engineer.

1.04 Quality Assurance

- A. Manufacturers of equipment shall be firms capable of showing at least five years of experience in the design and manufacture of natural gas equipment.
- B. Installation of natural gas system components shall be performed by skilled workers experienced in the installation of gas systems employed by and under direct supervision of a licensed contractor.

1.05 Coordination

- A. Installation scheduling of natural gas system components shall be coordinated with the building construction schedule to cause no delays in the execution of other portions of the construction contract.
- B. Coordinate natural gas service requirements with the local gas company for proper meter selection and installation.

Part 2 Products

2.01 Pipe and Fittings

- A. Pipe shall be Schedule 40 black steel, ASTM A 53 or A 106.
- B. Outdoor aboveground piping shall be primed and painted with products suitable for the installation environment. Coordinate finish color selection with the Engineer.
- C. Pipe Fittings
 - 1. Malleable Iron, ASTM A 197, screwed end, 150 psig rated.
 - 2. Steel butt-weld or socket-weld pipe fittings, Schedule 40.
- D. Outside underground pipe shall be polyethylene gas piping, Type PE3408 in accordance with ASTM D 2513 if operating pressure is less than 15 psig.

2.02 Valves and Accessories

- A. Valves and accessories shall be AGA certified and stamped certifying compliance with ANSI Z21.15, ANSI Z21.18 or ANSI Z21.21 as applicable.
- B. Shutoff valves 2-inches and smaller shall be cast iron body gas cock, threaded ends; Crane No. 1228, Nibco or Stockham.
- C. Shutoff valves greater than 2-inches shall be cast iron body gas cock, threaded ends; Crane No. 324, Nibco or Stockham.

Part 3 Execution

3.01 Pipes and Fittings

- A. Install piping in accordance with NFPA 54 National Fuel Gas Code.
- B. Test all piping in accordance with NFPA and the Standard Gas Code.
- C. Plastic piping shall be buried underground entirely and shall not be used within or under any building or slab.
- D. Gas piping shall be electrically continuous and bonded to a grounded electrode but shall not itself be used as a grounding electrode.
- E. Underground gas piping shall also be installed in accordance with Section 02610.

3.02 Demonstration

- A. The Contractor shall instruct Owner's personnel in proper operation and maintenance of gas system components after final system testing is completed.
- B. Provide written confirmation to the Owner that the gas system has been tested, inspected by the authority having jurisdiction, and is in satisfactory working order.

END OF SECTION



Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to the provisions Section 15050.
- B. Furnish and install gas fired heaters of the size, type, capacity, and characteristics described within the Contract Documents.

1.02 References

- A. The latest edition of the publications listed below are included as part of these Contract Documents.
 - 1. Standard Gas Code
 - 2. American Gas Association (AGA) Standards
AGA Certification
 - 3. Underwriter's Laboratory (UL) Standards
UL 795 Commercial-Industrial Gas-Heating Equipment
 - 4. National Fire Protection Association (NFPA) Standards
NFPA 54 National Fuel Gas Code
NFPA 70 National Electrical Code
 - 5. American National Standards Institute (ANSI) Standards
ANSI Z21.47 Gas-Fired Central Furnaces
ANSI Z21.11 Gas-Fired Room Heaters
ANSI Z83.6 Gas-Fired Infra-Red Heaters
ANSI Z83.18 Gas-Fired Industrial Air Heaters

1.03 Submittals

- A. Submit shop drawings and product data in accordance with Division 1 and Section 15050.
- B. Submit information on the following:
 - 1. Motor.

Gas Fired Make-Up Air Units

2. Fuel input.
3. Heat output.
4. Efficiency.
5. Materials of construction.
6. Controls.
7. Mounting methods.

Part 2 Products

2.01 General

- A. Provide units to operate on natural gas at 7 - 11-inches water column.
- B. Provide units with spark-ignited electronic ignition.
- C. Control gas flow with thermostat based on space temperature. Locate thermostat on wall five feet AFF unless otherwise shown on the Drawings.
- D. Disconnect switches shall be provided for mechanical equipment in accordance with the National Electrical Code. Coordinate type (fused or not), fuse ratings, enclosure type and installation with equipment nameplate, NEC, NEMA and Sections 16050 and 16440 requirements.

2.02 Make-Up Air Units

- A. Provide gas-fired, fully insulated, double-walled, packaged make-up air units. The units shall be designed for direct fired combustion, arranged for either ceiling suspension or base mounting as shown on the Drawings. The insulation shall be of 1-inch thick and 1-1/2 pound density.
- B. The units shall include a centrifugal blower, motor, adjustable belt drive, motorized inlet damper, and controls.
- C. Provide a structurally reinforced aluminized steel cabinet with watertight access panels. The housing shall be primed and enamel coated. The entire unit shall be of industrial grade construction. The unit shall be tested and certified for minimum 5000 hours of resistance to corrosion under salt spray testing in accordance with ASTM B117-73 and shall be completely weatherproofed.
- D. The blower shall be double width - double inlet (DWDI), forward curved centrifugal with painted steel wheel and housing. The fan wheel shall be statically and dynamically balanced. The bearings shall have permanently lubricated, self-aligning, sealed bearings. The fan shaft shall have a corrosion resistant coating.

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- E. The motor shall be open drip-proof, designed for continuous duty at the voltage scheduled with a 1.15 service factor.
 - F. The fan drive shall be belt driven, designed for 1.5 minimum service factor based on motor horsepower.
 - G. Provide filter section on unit inlet sized to contain 2-inch thick, 30 percent efficient (ASHRAE 52) throwaway filters of readily available sizes. Provide filter section with an indicating light for dirty filters.
 - H. Provide spring-type vibration isolators. Provide internal vibration isolation for blower and motor.
 - I. Provide extended grease lines to allow lubrication of all bearings from one location.
 - J. Provide modulating FM gas train suitable for gas supply at 10-inch water column. Gas controls shall be electronic modulating type with 25:1 turndown ratio.
 - K. Provide ultra-violet flame sensor suitable for condensing conditions.
 - L. Provide low discharge temperature shut down controls.
 - M. Provide E3 (409) stainless steel burners.
 - N. Provide with outside air intake louvers or weather hood with birdscreen.
 - O. Provide insulated aluminum roof curb. The curb shall be 16-inches high. Construction of curb shall allow for roof slope to provide for level installation of make-up air unit.
 - P. Provide a unit mounted or remote control panel as indicated on the equipment schedule. The panel shall have an enclosure with a NEMA rating as required by Division 16 or shown on the Drawings containing the following:
 - 1. Firing controls.
 - 2. Status lights.
 - 3. Relays and contactors.
 - 4. Starters.
 - 5. Single point power connection.
 - 6. Step down and control transformers.
 - 7. High and low air temperature sensors.
 - 8. High limit switch.

Gas Fired Make-Up Air Units

9. Discharge air temperature sensor.
 10. Summer-off-winter switch.
- Q. Provide a unit mounted disconnect meeting the requirements of 16050.
- R. Sequence of Operation
1. The make-up air unit (MAU) shall run subject to the following safeties:
 - a. When the low limit temperature sensor, located in the unit discharge senses a temperature below low limit temperature sensor setpoint (adjustable), the burner shall be shut off, the blower shall be stopped and the outside air damper shall be closed.
 - b. When the high limit temperature sensor, located in the unit discharge, senses a temperature above high limit temperature sensor setpoint (adjustable), the burner shall be shut off and the blower shall continue to operate.
 - c. When any safety mode is activated, an audio-visual alarm shall be sent to the unit's control panel.
 2. When the unit is activated, the blower shall be started and the outside air damper shall open.
 3. A temperature sensor, located in the unit discharge, shall modulate the burner control valve to maintain a constant discharge air temperature setpoint (adjustable).
 4. A space mounted thermostat shall override the discharge temperature sensor to maintain the space temperature setpoint (adjustable).
- S. Acceptable Manufacturers: Industrial Commercial Equipment (ICE), Reznor, Jackson and Church, or Concept and Designs, Inc.

Part 3 Execution

3.01 Installation

- A. Install in accordance with manufacturer's recommendations and the Contract Documents.
- B. Install gas piping to unit with dirt leg at supply connection, 6-inches minimum.
- C. Mount units on factory supplied roof curbs.

- D. Provide vibration isolation.

3.02 Field Quality Control

- A. Start-up and adjust gas-fired heaters for proper operation.
- B. Verify proper operation of all unit safety controls.

END OF SECTION



Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to the provisions of Section 15050.
- B. Furnish, install and test packaged rooftop air conditioning units of the capacities scheduled and at the locations indicated on the Contract Documents.

1.02 References

- A. The latest edition of the publications listed below are included as part of these Contract Documents.
 - 1. International Mechanical Code
 - 2. Underwriter's Laboratory (UL) Standards
 - 3. American National Standards Institute (ANSI) Standards
 - ANSI/ASHRAE 15 Safety Code for Mechanical Refrigeration
 - ANSI/ASHRAE 37 Unitary Air Conditioning and Heat Pump Equipment
 - 4. National Fire Protection Association (NFPA) Standards
 - NFPA 70 National Electrical Code
 - NFPA 90A Installation of Air conditioning and Ventilating Systems
 - 5. Air Moving and control Association (AMCA)
 - AMCA 210 Laboratory Methods for Testing Fans for Rating
 - AMCA 301 Method of Publishing Sound Ratings for Air Moving Devices
 - 6. Air Conditioning and Refrigeration Institute (ARI)
 - ARI 210 Unitary Air-Conditioning Equipment

1.03 Submittals

- A. Submit product data in accordance with the provisions of Division 1 and Section 15050.
- B. Submittal data shall be complete with dimensional and performance data sufficient to verify conformance with all scheduled unit capacities.

Packaged Air Conditioning Units

- C. Submit installation and start-up instructions for units and all accessory items.
- D. Submit product data on the following at the minimum:
 - 1. Identification by equipment number.
 - 2. Performance Data: Including air quantity, KW input, brake horsepower, fan rpm, velocities, and pressure drops across various sections of the unit.
 - 3. Equipment operating weight.
 - 4. Catalog data marked to indicate specified components used.
 - 5. Unit specifications and Drawings describing construction methods, including materials, metal gauges, and component spacing and thickness.
 - 6. Fan characteristic curve for each fan selection.
 - 7. Operating sound level data of fan.
 - 8. Arrangement of unit.
 - 9. Complete dimensional data of each respective unit.
 - 10. Arrangement, locations, and size of drains and electrical connections.
 - 11. Complete cooling performance for unit.
 - 12. Complete description of filter media including materials, thickness, efficiency, and pressure drop at design airflow rates.

1.04 Warranty

- A. The warranty shall prevail through the first 12 months following start-up (compressors shall be guaranteed for a period of five years following start-up).
- B. Normal wearing items such as air filters, fan belts, etc. are excluded from this coverage.

Part 2 Products

2.01 Acceptable Manufacturers

Units shall be manufactured by Trane, McQuay, or York.

2.02 Unit Description

Units shall be shop fabricated, completely factory-assembled, tested, piped, internally wired, and shipped in one piece. Unit shall be designed for outdoor installation. Unit shall contain a complete charge of refrigerant and compressor oil. Unit shall have DX cooling section, supply air fan, filters, hood, dampers, fan and compressor starters, non-fused disconnect switch, and all operating and safety controls shall be furnished and factory installed. Unit shall be factory run tested. Provide factory roof curb.

2.03 Unit Construction

A. Casing

1. The casing shall be completely weatherproofed with all seams factory sealed. Exterior panels shall be heavy zinc-coated steel, phosphatized, coated with epoxy primer and completely finished with baked enamel finish coat. The surface shall be salt spray tested for 500 hours in compliance with ASTM B117. Screws shall be coated with zinc plus zinc chromate and shall have neoprene gaskets.
2. Cabinet construction shall allow for all maintenance on one side of the unit. Provide hinged access doors, with latches, to all controls, compressors, filter section, fan sections, and evaporator section.
3. All interior surfaces or exterior casing members in contact with airstream shall have 1-inch thick, matt-faced, fire-resistant fiberglass insulation. An insulated drain pan shall be provided under the complete fan and cooling coil section with accessible drain connections on each side of the unit. Unit base shall be a one-piece welded assembly and curb overhang. Unit shall have factory installed lifting lugs.

B. Condensing Section

1. Condensing unit section shall include semi-hermetic or scroll compressors. Compressors shall be mounted on vibration isolators. Compressors shall be provided with an oil pump and suction and discharge service valves. Each compressor shall have crank case heaters and discharge line muffler. Compressors shall be capable of operation down to 35 degrees F outdoor temperature.
2. Air cooled condenser coil shall be multi-row type and have sufficient capacity to allow operating at a maximum of 120 degrees F outdoor temperature. Coil shall be copper tube-aluminum fin construction. Coil shall be leak tested to 200 psig and pressure tested to 450 psig.
3. Condenser fans shall be direct-driven propeller type with permanently lubricated bearings. The fans shall be statically and dynamically balanced and shall have built-in thermal overload protection. Provide hail protection quality coil guards for condenser coil protection.
4. Capacity reduction shall be provided by cylinder unloading and hot gas bypass.

C. Evaporator

1. Evaporator section shall include a multi-row direct expansion coil. Coil shall have a maximum of twelve fins per inch and a minimum of eight fins per inch. Coils shall be copper tube-aluminum fin. Coil shall be leak tested to 200 psig and pressure tested to 450 psig. Coil performance shall be certified in accordance with ASHRAE 15.
2. Each refrigerant circuit shall include a thermostatic expansion valve (TXV) to control refrigerant flow, solenoid valve, moisture indicator, and liquid line dryer, all mounted outside the airstream. Suction line shall be insulated.

D. Supply Fan

1. Supply fan shall be belt driven, centrifugal type with forward curved wheel, and adjustable motor sheaves. Fan shall be statically and dynamically balanced at the factory.
2. Fan motor shall be sized for horsepower required and motor RPM shall not exceed 1800 RPM. Motor shall be heavy-duty open drip proof type.
3. The entire fan assembly shall be isolated from the unit casing with spring isolators.

E. Filters

1. Filters shall be 2-inch thick, disposable, 30 percent efficiency as determined by ASHRAE Standard 52.
2. A spare set of filters for each unit shall be delivered to the Owner.

F. Unit Controls

1. Unit shall be completely factory wired and shall have single-point power connection. All controls necessary for operation shall be furnished by the unit manufacturer. Unit controls shall be complete with main power disconnect switch, fuses, starters, contactors, relays, switches, firestats, control transformer, and 115 volt convenience outlet.
2. Compressor operating and safety controls shall include high and low pressure switches, overloads, freezestat, anti-recycle timing device, and low ambient lock-out.

Part 3 Execution**3.01 Product Handling**

Each part of the unit shall be properly preserved and packed in accordance with the

manufacturer's standard practice. All components that may be subjected to damage during shipment and handling shall be adequately braced and protected to prevent damage to the equipment. Instructions for proper unpacking and handling shall be furnished. All parts shall be prepared for shipment in a manner to ensure carrier acceptance and safe delivery to designated location at the lowest applicable rate.

3.02 Start-Up Services

- A. Provide services of a qualified factory-trained, certified technician to supervise the start-up of the equipment specified under this Section.
- B. The manufacturer's service representative shall provide technical direction for the following work:
 - 1. Inspection and final adjustments.
 - 2. Operational and functional checks of the units.
 - 3. Training of the Owner's representative on the proper maintenance and operation of the equipment.
- C. The manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.

END OF SECTION

Part 1 General

1.01 Scope

- A. All work specified in this Section is subject to the provisions of Section 15050.
- B. Furnish and install electric heaters of the type and capacity scheduled in the Contract Documents.

1.02 References

- A. The latest edition of the publications listed below are included as part of these Contract Documents.
 - 1. International Mechanical Code
 - 2. National Fire Protection Association (NFPA)
 - NFPA 70 National Electrical Code (NEC)
 - NFPA 90A Installation of Air Conditioning and Ventilating Systems
 - 3. Underwriters Laboratories (UL) - UL listed products

1.03 Submittals

- A. Submit product data in accordance with the provisions of Sections 01340 and 15050.
- B. Submit product data on all products proposed for installation under this Section, including but not limited to the following:
 - 1. Fan forced wall heater.
 - 2. Explosion proof unit heater.
- C. Submittal data shall include catalog cuts and other information required to evaluate conformance with these Specification requirements. Data submitted shall include at least the following:
 - 1. Materials of construction.
 - 2. Heating capacity.
 - 3. Electrical requirements.
 - 4. Accessory items.

Electric Heaters

5. Installation and maintenance instructions.
6. Disconnects.

1.04 Coordination

Electric heaters of a specific manufacturer have been used as the basis of design. Any modifications to controls, electrical connections, structural supports, etc., that result from the use of equipment by any other manufacturer shall be coordinated with all other trades; this coordination shall occur before delivery of the equipment from the manufacturer. Any modifications shall be performed without incurring additions to the Contract.

Part 2 Products

2.01 Fan Forced Wall Heater

- A. Fan forced wall heater shall be of tamperproof type designed for heavy duty commercial use. Heater shall be self-contained with integral thermostat.
- B. Heating elements shall be finned tubular type.
- C. Fan shall be propeller type with factory lubricated motor.
- D. Front cover shall be heavy gauge steel construction. Unit shall be finished in baked enamel.
- E. Heater shall be complete with thermal overload protection.
- F. Heater shall be UL Listed.
- G. Acceptable Manufacturers: Chromalox or Q-Mark.

2.02 Explosion Proof Unit Heater

- A. Explosion-proof heater shall be of minimum 14 gauge steel construction with polyester powder coat paint finish. The heater shall have adjustable louvers to control the direction of airflow.
- B. The heating elements shall be constructed of copper, rugged and seamless, immersed in sealed liquid-to-air heat exchanger. The heat exchanger shall be constructed of steel tubes with integral aluminum fins and filled with glycol-water heat transfer fluid. The heat exchanger shall be factory Helium leak tested to assure a leak-proof design.
- C. The fan motor shall be explosion-proof type with permanently lubricated bearings and built-in thermal overload protection.

- D. The fan shall be constructed of epoxy coated Aluminum to prevent sparking.
- E. The heater shall have pre-wired explosion-proof control center with magnetic contactor and control circuit transformer.
- F. Acceptable Manufacturers: Model CXH-A by Chromalox or equal by Q-Mark.

Part 3 Execution

3.01 Installation

- A. Electric heaters shall be installed in complete conformance with the manufacturer's recommendations and the Contract Documents.
- B. Coordinate electrical construction with heater installation.
- C. Mount wall mounting brackets rigidly to building structure with amply sized anchor bolts or machine bolts.
- D. Touch up any epoxy painted surfaces damaged during installation with paint materials recommended by the heater manufacturer.

3.02 Demonstration

- A. Test operating controls for proper heater operation to maintain temperature setpoint conditions.
- B. Verify proper operation of all safety controls.
- C. Adjust discharge louvers for even air distribution in the heated space.

END OF SECTION



Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to the provisions of Section 15050.
- B. Furnish and install unitary fans of the size, type, capacity and characteristics described within the Contract Documents.

1.02 References

- A. This specification references the latest edition of the publications listed below. Work shall be performed and materials shall be furnished in accordance with these publications as reference herein.

- 1. International Mechanical Code
- 2. Underwriter's Laboratories (UL) Standards
 - UL 705 Power Ventilators
- 3. National Fire Protection Association (NFPA) Standards
 - NFPA 70 National Electrical Code
 - NFPA 90A Installation of Air Conditioning and Ventilating Systems
- 4. Air Movement and Control Association (AMCA) Standards
 - AMCA 99 Standards Handbook
 - AMCA 210 Laboratory Methods of Testing Fans for Rating Purposes
 - AMCA 300 Test Code for Sound Rating Air Moving Devices
- 5. American Society for Testing and Materials (ASTM) Standards
 - D 4167 Standard Specification for Fiber-Reinforced Plastic Fans and Blowers

1.03 Submittals

- A. Submit product data in accordance with the provisions of Sections 01340 and 15050.
- B. Submit product data on all products proposed for installation under this Section, including but not limited to the following:
 - 1. Wall-mounted propeller fans.

Fans

2. FRP centrifugal roof exhaust fans.
 3. Ceiling mounted exhausters.
- C. Submittal data shall include catalog cuts, performance curves and other information required to evaluate conformance with these Specification requirements. Data submitted shall include at least the following:
1. Materials of construction.
 2. Fan performance data and AMCA certification.
 3. Fan motor, horsepower, starters, electrical data and/or disconnects where specified or shown.
 4. Fan accessories.
 5. Installation and maintenance instructions.
 6. Spare parts lists.
 7. Disconnect switches where specified herein.
- D. Motors shall meet the requirements of Division 16.

1.04 Quality Assurance

- A. Provide factory built and tested fan equipment. Test fans in accordance with AMCA 210 and 300. Fans shall bear the AMCA Certified Performance Seal for both air and sound performance.
- B. Provide factory balanced fan wheel and shaft assemblies. Provide statically and dynamically balanced fan assemblies. Imbalance shall not exceed limitations of the fan bearings for maximum rated design life.
- C. Belt drives shall be designed for not less than 150 percent of the connected driving capacity. Motor sheave shall be adjustable to provide not less than 20 percent speed variation. Sheaves shall be selected to drive the fan at a speed to produce the scheduled capacity when set in the approximate midpoint of the sheave adjustment. Motors with V-belt drives shall be provided with adjustable bases.
- D. Units shall be rigidly constructed of materials suitable for the intended service and shall be installed with accessories listed on the Contract Documents.
- E. Fans shall bear the Underwriter's Laboratories label.

Part 2 Products

2.01 Wall-Mounted Propeller Fans

- A. Provide belt driven sidewall propeller fans complete with fan blade, one piece steel fan panel with spun venturi and driver support frame, motor and drive, bearings, gravity shutter, motor side guards and mounting collars.
- B. The propeller fan blades shall be of cast aluminum construction with airfoil design. Provide cast aluminum hub keyed and locked to the shaft utilizing two set screws or a taper lock bushing.
- C. The steel fan panel shall be of one piece construction with spun venturi, formed flanges and welded corners. The fan panel shall have a drive support frame providing a rigid platform for the motor and shaft. Provide electrostatically applied, baked polymer powder coating.
- D. Fan shaft shall be ground and polished steel with slotted keyways.
- E. Bearings shall be ball bearing pillow block type. Bearing shall be rated for L-50 life of minimum 200,000 hours.
- F. Provide matching factory fabricated OSHA compliant wire guards, mounting collars, and heavy-duty gravity shutters.
- G. The fan shall be of spark resistant construction with explosion proof motor.
- H. Acceptable Manufacturers: Greenheck or Loren Cook.

2.02 FRP Centrifugal Roof Exhaust Fan

- A. Provide FRP centrifugal, belt driven, roof fan complete with roof curb, backdraft damper, and stainless steel bird screen. The fan shall be of AMCA A spark resistant construction. The fan housing shall be aerodynamically designed with high efficiency inlet, engineered to reduce incoming air turbulence. The housing shall be smooth, both exterior for aesthetic appearance, and interior for unrestricted airflow. The housing shall be manufactured using specifically formulated resins for maximum corrosion resistance, UV inhibited and reinforced with fiberglass for structural strength. Interior surfaces of the housing shall be resin rich. No metal parts shall be exposed to air stream. The fan shall have a flame retardancy of 25 or less.
- B. Fan impeller shall be solid molded FRP with radial tip curved blades. The FRP hub shall have tight fitting cap to protect shaft end and to extend outside the casing. Provide Teflon shaft seal. Impellers manufactured in steel and coated with plastic material are not acceptable. The impeller shall be statically and dynamically balanced to Grade GS.3 per AMCA 204 Standard.

Fans

- C. Fan motor shall be TEFC with 1.15 service factor and suitable for continuous operation. The fan belt and pulleys shall be easily accessible for service and maintenance. Bearings shall be permanently sealed type rated for L-50 200,000 hours. Provide variable pitch drives for belt drives up to 5 HP.
- D. Provide fan mounted PVC NEMA 3R disconnect switch.
- E. The insulated roof curb constructed of FRP shall be provided by the fan manufacturer to assure proper fit between fan curb cap and roof curb. The curb shall be 18-inches high. Construction of the curb shall account for roof slope. The roofing flange shall be the 45 degree cant type.
- F. The roof curb shall be furnished with a gravity backdraft damper properly sized to attach to a mounting flange in the curb base. The damper shall be of FRP construction.
- G. Acceptable Manufacturers: MK Plastic Corporation, Twin City Fan Companies.

2.03 Ceiling Mounted Exhausters

- A. Provide centrifugal, direct-driven ceiling exhausters. Fan housing shall be acoustically insulated and constructed of heavy gauge galvanized steel. The entire fan, motor and wheel assembly shall be removable for servicing. Fan wheel shall be centrifugal forward curved type, constructed of galvanized steel.
- B. Provide fan with integral chatter proof backdraft damper and aluminum wall cap accessory. Provide fan mounted speed controller.
- C. Acceptable Manufacturers: Greenheck or Loren Cook.

Part 3 Execution

3.01 Installation

- A. All units shall be installed in accordance with manufacturer's recommendations and as shown on the Drawings. Provide adequate supports from wall or structure to prevent sagging, vibration and damage.
- B. Units shall be interlocked and controlled as shown on the Drawings and as described in Section 15950 of these Specifications.

3.02 Ceiling Mounted Exhausters

Install ceiling fans where shown on the Drawings. Support fan from building structure, not on ceiling grid. Install wall curb or cap in wall opening, caulk to provide a weatherproof seal. Verify proper backdraft damper operation.

3.03 Roof Mounted Fans

- A. Install roof curb with roofing. Extend roof flashing up and over the roof curb sides. Mount backdraft damper to curb, not to roof.
- B. Mount fan level on roof curb after bonding a rubber gasket to roof curb top edge. Secure fan to curb with lag bolts through fan curb cap into curb wood nailer. Use a minimum of two lag bolts each fan side, with 12-inches maximum distance between bolts. Caulk between fan curb cap and curb to provide a weathertight seal.

3.04 Demonstration

- A. Verify proper rotation of fan wheel.
- B. Verify proper operation of backdraft damper.
- C. Adjust fan speed by adjusting or replacing sheaves to obtain proper air flow.

END OF SECTION



Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to provisions of Section 15050.
- B. Provide materials, labor, accessories, and duct supports necessary to completely fabricate and install ductwork shown on the Contract Documents.

1.02 References

- A. The latest edition of the publications listed below is included as part of these Contract Documents:
 - 1. International Mechanical Code
 - 2. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) Standards
 - a. HVAC Duct Construction Standards
 - b. HVAC Systems Duct Design
 - c. Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
 - d. Rectangular Industrial Duct Construction Standards
 - e. Round Industrial Duct Construction Standards
 - 3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standards
 - a. Fundamentals
 - b. Equipment
 - c. HVAC Systems and Applications
 - d. Refrigeration
 - 4. National Fire Protection Association (NFPA) Standards
 - NFPA 90A Installation of Air Conditioning and Ventilating Systems
 - NFPA 90B Warm Air Heating and Air Conditioning Systems
 - 5. Underwriter's Laboratories (UL) Standards
 - UL 181 Factory Made Air Ducts and Connectors

Ductwork

6. Air Diffusion Council (ADC) Standards
ADC FD-72 R1 Flexible Air Duct Test Code
7. American Society for Testing and Materials (ASTM) Standards
ASTM A 90 Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
ASTM A 525 General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 527 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock Forming Quality

1.03 Submittals

- A. Submit product data in accordance with the provisions of Division 1 and Section 15050.
- B. Submit product data on all products proposed for installation under this Section, including but not limited to the following:
 1. Duct material product data.
 2. Ductwork layouts (not less than 1/4-inch scale).
 3. Duct joint installation methods.

1.04 Quality Assurance

- A. Work shall be performed in a neat, proficient manner by skilled workers experienced in the fabrication and installation of ductwork systems of similar complexity.
- B. The Contractor shall demonstrate experience on at least 10 projects requiring similar fabrication and installation methods.

1.05 Delivery, Storage, and Handling

- A. Material shall be delivered and stored on the Project site in a manner to protect from dirt, moisture, and physical damage. The Contractor shall be responsible for providing the on-site storage facilities.
- B. Do not install materials damaged prior to installation. Replace damaged materials with new materials.

1.06 Sequencing and Scheduling

- A. Coordinate installation schedule of ductwork with overall building construction schedule.
- B. Coordinate installation locations of ductwork with the work of other trades to maximize the accessibility and maintainability of all building systems.

Part 2 Products

2.01 Description

- A. SMACNA Standards indicated shall mean standards published by the Sheet Metal and Air Conditioning Contractor's National Association, Inc. Ductwork shall be constructed in complete conformance with the latest edition of the SMACNA Manual. Duct classification shall be as follows unless shown on the Drawings otherwise:
 - 1. All ductwork unless noted otherwise: Medium Pressure - 4-inches static pressure, Class A Seals.
 - 2. General exhaust ductwork: Low Pressure - 1/2-inch static pressure, Class B Seals.
- B. Ductwork shall be round or rectangular as indicated on the Drawings. Sizes given shall be considered to be the minimum, and any conversion from the given shape shall be made without increasing air velocity or friction losses. All duct dimensions indicated are net clear inside dimensions. Materials of construction of ductwork shall be as follows, unless shown on the drawings otherwise:
 - 1. Ductwork shall be constructed of aluminum in the following systems:
 - a. All supply and return ductwork in the air-conditioning system serving the Electrical Room located in the Chemical Building.
 - b. All ductwork carrying toilet exhausts in the Chemical Building.
 - 2. Ductwork shall be constructed of fiberglass-reinforced plastic in the following systems. Fiberglass reinforced plastic ductwork is specified in Section 15892.
 - a. Unless noted otherwise, all ventilation supply and exhaust ductwork serving various areas in the Chemical Building.

2.02 Low Pressure Ductwork

Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

2.03 Medium Pressure Ductwork

Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and ASHRAE Handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for the operating pressures indicated.

Part 3 Execution

3.01 General

- A. Transitions shall be made with a slope not exceeding 1 in 4 where space permits.
- B. Transverse joints shall be sealed in accordance with SMACNA HVAC Construction Standards "Duct Sealing Requirements" with UL listed mastics.
- C. Round duct shall be connected to rectangular duct using spin-in fittings with scoop and damper or scoop only with no damper as indicated on the Drawings.
- D. Install and support ductwork per SMACNA Standards.

3.02 Sheet Metal Work

Unless otherwise specified or shown on the Drawings, construct and install all sheet metal work in accordance with the latest edition of SMACNA Duct Construction Standards.

3.03 Field Quality Control

- A. All ductwork shall be leak tested in accordance with SMACNA Air Duct Leakage Test Manual and shall be sealed to provide a system that is within the allowable leakage limits. The ductwork test report shall be submitted to the Engineer.
- B. If the system is tested in sections, the leakage rates shall be added to define the performance of the whole system. Leakage concentrated at one point may result in objectionable noise, even if the system passes the leakage rate criteria. This noise source must be corrected to the satisfaction of the Engineer.
- C. Ductwork shall be insulated where shown on the Drawings or specified in Section 15250.

END OF SECTION

Fiberglass Reinforced Plastic Ductwork

Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to provisions of Section 15050. The ductwork systems fabricated of fiberglass reinforced plastic (FRP) are listed in Part 2 of Section 15890.
- B. Provide materials, labor and accessories necessary to completely fabricate and install ductwork shown on the Contract Documents.

1.02 References

- A. This specification references the latest edition of the publications listed below. Work shall be performed and materials shall be furnished in accordance with these publications where referenced herein:

- 1. American Society for Testing and Material (ASTM) Standards

ASTM C 582	Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment
ASTM D 2310	Classification for Machine-Made "Fiberglass" (Glass Fiber-Reinforced Thermosetting Resin) Pipe
ASTM D 2583	Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM D 2996	Specification for Filament-Wound "Fiberglass" (Glass Fiber-Reinforced Thermosetting Resin) Pipe
ASTM D 3567	Practice for Determining Dimensions of "Fiberglass" (Glass Fiber-Reinforced Thermosetting Resin) Pipe and Fittings
ASTM D 3982	Contact Molded "Fiberglass" (Glass Fiber Reinforced Thermosetting Resin) Duct and Hoods
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials

1.03 Submittals

- A. Submit product data in accordance with the provisions of the General Conditions and Section 15050.
- B. Submit product data on all products proposed for installation under this Section,

Fiberglass Reinforced Plastic Ductwork

including but not limited to the following:

1. Statement of resins and reinforcing proposed for use along with resin and reinforcing manufacturer's product literature.
2. Manufacturer's data and descriptive literature for duct accessories.
3. Shop drawings, sealed by a Professional Engineer, registered in the State of Kentucky depicting the following information:
 - a. Dimensioned duct layout. (Not less than 1/4-inch scale.)
 - b. Locations of supports, hangers, anchors, guides and expansion joints.
 - c. Joints used at each connection and detail of each joint type.
4. Provide certification sealed by a Professional Engineer registered in the State of Kentucky substantiating conformance with duct design criteria specified herein.
5. Joint fabrication and/or installation instructions.
6. Three duct material samples of a minimum size of 8-inches by 8-inches each for testing by an independent laboratory designated by the Engineer. Sample shall be representative of the materials of construction and workmanship proposed for installation on the project. Random samples may be collected from the construction site for testing after start of duct erection at the discretion of the engineer.
7. Duct color chart.
8. Detailed information regarding any proposed design modification.

1.04 Quality Assurance

- A. Work shall be performed in a neat, proficient manner by skilled workers experienced in the fabrication and installation of ductwork systems of similar complexity.
- B. The Contractor shall demonstrate experience on at least 10 projects requiring similar fabrication and installation methods. Both the Fabricator and the Installer shall have a minimum of five years experience for similar projects.

1.05 Delivery, Storage, and Handling

- A. Material shall be delivered and stored on the Project site in a manner to protect from dirt, moisture, and physical damage. The Contractor shall be responsible for providing on-site storage facilities.
- B. Do not install materials damaged prior to installation. Replace damaged materials with new materials.

1.06 Sequencing and Scheduling

- A. Coordinate installation schedule of ductwork with overall building and site construction schedule.
- B. Coordinate installation locations of ductwork with the work of other trades to maximize accessibility and, where necessary, operability and maintainability of all process and building systems.

Part 2 Products

2.01 Acceptable Manufacturers

Acceptable manufacturers for fiberglass reinforced plastic ductwork shall be Tankinetics, Augusta Fiberglass, Industrial Plastic Systems, Beetle Plastics, All Plastics, and Southeastern Fiberglass Products.

2.02 FRP Ductwork Design Requirements

- A. Service Conditions
 - 1. Duct Contents: Ventilation air laden with corrosive chemical vapors.
 - 2. System vacuum rating shall be 6-inch WG (minimum).
 - 3. Ambient Temperature: 40 to 105 degrees F.
 - 4. Gas Temperature: Ambient.
 - 5. Location: Indoors. See Drawings.
 - 6. Seismic Requirements: Per International Building Code.
- B. Duct Support Criteria
 - 1. Maximum Duct Deflection: 1/2-inch (between supports).
 - 2. Support spacing shall not exceed the following unless noted on the Drawings.
 - a. 20-inch diameter and smaller duct: 15 feet, maximum.
 - b. 24-inch and larger duct: 20 feet, maximum.
- C. Duct Design
 - 1. Duct shall be filament wound or contact molded, glass fiber reinforced vinylester resin pipe with a reinforced vinylester resin liner. Filament wound construction

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shall conform with the requirements of ASTM D 2996. Contact molded construction shall conform with the requirements of ASTM C 582 and ASTM D 3982.

2. Duct wall thickness shall be designed by the duct supplier such that the maximum listed deflection is not exceeded using the service conditions and duct support criteria stated above. However, structural layer wall thickness shall be greater than the minimum allowable thicknesses as indicated below:

Duct Diameter (inches)	Minimum Allowable Structural Layer Thickness (inches)
2 - 36	0.187
42-60	0.250
72-96	0.375

The structural wall thickness shall be the greater of the calculated value or the minimum values listed above. The inner surface and interior layer shall not be allowed for inclusion in the structural wall thickness. Only the structural layer as described below shall be used for deflection criteria calculations and minimum allowable structural layer thickness. Rectangular ductwork thickness shall be determined by substituting the long side dimension for the round equivalent diameter thickness.

3. Unless stated otherwise, all remaining aspects of the duct design shall be in accordance with ASTM D 3982.
4. Fitting Design
 - a. Fitting construction shall be the same as that for duct.
 - b. Minimum fitting wall thickness shall match thickness for duct of corresponding sizes.
 - c. Bends shall either be contacted molded or fabricated from straight duct with the following miter segments:
 - i. Bends up to 30 degrees - 1 miter/2 gore.
 - ii. 31 to 60 degree bend - 2 miter/3 gore.
 - iii. 61 to 90 degree bend - 4 miter/5 gore.
5. Joints
 - a. All joints shall be butt wrapped except those at connections to butterfly air valves, expansion joints and mechanical equipment which shall be

flanged. Butt wrapped joints shall be constructed in accordance with ASTM D 3982.

- b. Where flanges are used, they shall have bolt hole patterns meeting ASTM D 3982 dimensions. Flange gaskets shall be full face ASTM D 2240, Type A, suitable for 160 degrees F continuous operating temperature and constructed of neoprene. Flange nuts, bolts and washers shall be Type 316 stainless steel.
- c. All joints shall be made of the same resin material as the duct and shall meet or exceed the hoop tensile and axial strength requirements of the duct.

2.03 Resin

Resin shall be a premium grade vinylester product formulated to withstand chemical and environmental exposures and temperature range listed above. All duct shall meet a flame spread rating of 25 or less in accordance with ASTM E 84. Fillers, which shall be permitted only for flame retardance, shall not exceed five percent by weight. Vinylester resin shall be Derakane 510C, Hetron FR992, Corezyn 8440, or Reichold Dion 9300. No alternate resins shall be allowed for construction of duct.

2.04 Construction

- A. Inner Surface: Chemical surfacing material shall be Type C glass, be overlapped a minimum of 1-inch and saturated with resin for all overall thickness of 12 mils.
- B. Interior Layer: The interior layer shall consist of Type "E" chopped strand mat or chopped roving fibers saturated in resin. Interior layer thickness shall be a minimum of 96 mils. Fibrous content of layer shall not be less than 20 percent nor more than 30 percent by weight.
- C. Structural Layer: The structural layer shall consist of Type "E" continuous filament wound fibers saturated with resin in bi-directional layers, chopped strand mat plies, chopped roving or woven roving. Structural layer thickness shall be as required to meet the minimum duct thickness as specified in Article 2.02-C. Fibrous content of structural layer shall not be less than 50 percent nor more than 70 percent by weight.
- D. Post Coat: Exterior of duct shall contain sufficient resin to ensure a relatively smooth surface free of exposed glass fibers or sharp projections.
 1. Outdoor Duct: Furnish ultraviolet absorbers and colored gel coat on exterior of duct. Color shall be as selected by the Engineer.
 2. Indoor Duct: Furnish colored gel coat on exterior of duct. Color shall be as selected by the Engineer.
- E. The duct shall have a Barcol hardness of at least 90 percent of the resin manufacturer's minimum specified hardness for the cured resin when tested in

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accordance with ASTM D 2583.

F. Marking

1. Identify each duct component with the fabricators name, resin, minimum thickness, diameter (in inches) and date of manufacture.
2. Use permanent marking. Sealing decals and labels into laminate exterior with resin shall be acceptable.

2.05 FRP Round Dampers

- A. Provide single blade FRP dampers suitable for use with wet and corrosive airstreams. Damper frame shall have a resin rich corrosion barrier of minimum 100 mils thickness. Flange construction shall comply with NBS PS-15-69
- B. Damper bearings shall be molded PTFE.
- C. Dampers shall be provided with 316SS locking quadrant.
- D. FRP Dampers shall be Model 911 as manufactured by Swartwout or equal by Belco.

2.06 Accessories

- A. Duct Inspection Hatches: Furnish duct inspection hatches sized and located as shown on the Drawings. Hatches shall consist of blind flange covers bolted to integrally fabricated flanged openings. Furnish EPDM gaskets and Type 316 stainless steel nuts, bolts, and washers.
- B. Duct Hangers and Supports: Furnish all duct hangers, saddles, anchors, guides, bearing plates, EPDM inserts, and associated hardware for installation of duct.
 1. Duct hanger system shall be FRP with trapeze channel and straps and Type 316 stainless steel hardware. Resin shall be vinylester type. Duct hanger system shall be equal to Aickinstrut Aickentrapeze and Aickenstraps.
 2. Duct hangers and supports shall be installed per manufacturer's instructions.
 3. Anchor type support saddles shall provide lateral, vertical and longitudinal restraint. Guide type support saddles shall provide vertical and lateral restraint. Bearing type support saddles shall provide vertical restraint only. Provide EPDM insert between duct and support saddle. Duct saddle length shall be one-half duct diameter minimum.

Part 3 Execution

3.01 General

- A. Transitions shall be made with a slope not exceeding 1:4 where space permits.
- B. Ductwork shall be assembled from manufactured sections of duct and fittings.
- C. Ductwork joints shall be made-up in accordance with the duct fitting manufacturer's installation instructions.
- D. All transitions shall be flat on bottom unless otherwise noted.

3.02 Installation

- A. Verify dimensions and conditions in the field prior to preparing shop drawings and fabricating duct.
- B. All duct and fittings shall be thoroughly cleaned and inspected prior to installation and shall be kept clean until installed.
- C. Cut, fit and install duct in accordance with manufacturer's recommendations.
- D. Seal cut edges with compatible resin.
- E. Field Joints: Provide material for field joints in kit form; one kit for one joint.
- F. Install dampers in the locations shown on the Drawings and as required for balancing the system, true to alignment and properly supported.
- G. Install dampers between duct flanges with 316 stainless steel bolts and nuts, and washers.
- H. Support duct at both sides of each damper in a manner that allows removal of damper for maintenance without temporary duct support.

3.03 Duct Supports and Hangers

The Contractor shall be responsible for selecting and locating all indoor and outdoor supports and hangers. Contractor shall also select and locate all saddle types to ensure provision is made for adequate duct compression and expansion.

3.04 Field Quality Control

- A. All ductwork shall be leak tested in accordance with SMACNA Air Duct Leakage Test Manual and Section 15990. Duct system shall be sealed to provide a system that is within an allowable leakage limit of 5 percent of total air flow at system operating flow

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and pressure. The ductwork test report shall be submitted to the Engineer.

- B. If the system is tested in sections, the leakage rates shall be added to define the performance of the whole system.

END OF SECTION

Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to the provisions of Section 15050.
- B. Furnish and install ductwork accessories as necessary to install ductwork shown on the Contract Documents.

1.02 References

- A. This specification references the latest edition of the publications listed below. Work shall be performed and materials shall be furnished in accordance with these publications where referenced herein:
 - 1. International Mechanical Code
 - 2. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) Standards
 - a. HVAC Duct Construction Standards
 - b. HVAC Systems Duct Design
 - c. Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
 - d. Rectangular Industrial Duct Construction Standards
 - e. Round Industrial Duct Construction Standards
 - 3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standards
 - a. Equipment
 - b. HVAC Systems and Applications
 - c. Refrigeration
 - d. Fundamentals
 - 4. National Fire Protection Association (NFPA) Standards
 - NFPA 90A Installation of Air Conditioning and Ventilating Systems
 - NFPA 90B Warm Air Heating and Air Conditioning Systems

5. Underwriter's Laboratories (UL) Standards

UL 181 Factory Made Air Ducts and Connectors

UL 555 Fire and Radiation Dampers

UL 555S Leakage Rated Dampers for Use in Smoke Control Systems

1.03 Submittals

- A. Submit product data in accordance with the provisions of Sections 01340 and Section 15050.
- B. Submit product data on all ductwork accessories proposed for installation under this Section, including, but not limited to the following:
1. Air turning vanes
 2. Volume control dampers
 3. Backdraft dampers
 4. Fire dampers
 5. Spin-in collar fittings
 6. Flexible duct connectors
 7. Duct access doors
- C. Submittal data shall include catalog cuts, performance data, installation instructions and other information required to completely describe the proposed equipment and allow verification of conformance with the Specifications.

Part 2 Products**2.01 Air Turning Devices**

- A. Turning vanes shall be installed in all 90 degree square and rectangular elbows and at other locations shown. The turning vanes shall be double thickness type, with vanes secured to the runners and runners secured to the duct. Elbows in round ductwork and other radiused elbows shall have an inside radius equal to the diameter of the duct.
- B. Splitters shall be made of the same thickness aluminum as the duct, 24 gauge minimum securely attached to a rod at the air leading edge and made of two thicknesses so the leading edge presents a round nose to air flow. Length shall be equal to 1-1/2 times the width of the smaller duct; 12-inch minimum.

- E. Blades: Minimum 14 gauge extruded aluminum with extruded vinyl seals locked into blade edges; maximum length 48-inches. Pivot rods shall be plated steel or molded synthetic thermoplastic, ½-inch diameter or hex.

2.04 Fire Dampers

- A. Fire dampers shall be installed at all locations where ductwork penetrates any floor wall or partition with a fire rating of two hours or more or where otherwise shown on the Drawings. Fire dampers shall have a rating compatible with the floor, wall, or partition and shall be classified and labeled in accordance with UL 555.
- B. Fire dampers shall be of metal box frame construction with the damper located out of the air stream. Provide sleeve to match wall or floor thickness. Fire dampers shall be suitable for use in both static and dynamic systems.
- C. Fire dampers in the FRP ductwork shall be of minimum 14 gauge 304SS construction equal to Ruskin Model DIBD2 styles C or CR.
- D. Acceptable Manufacturers: Ruskin or Greenheck.

2.05 Spin-In Collar Fittings

Complete with air scoop and manual damper with locking device, for round duct connection to supply duct. Spin-in collars shall be by the same manufacturer as the flexible duct and shall be provided for each flexible duct take-off.

2.06 Flexible Duct Connections

- A. Flexible duct connections shall be non-combustible, installed at all belt-driven equipment and where shown. Material shall be glass fabric double coated with neoprene (30 ounces per square yard minimum).
- B. Provide duct supports on each side of flexible connections.
- C. Acceptable Manufacturers: Ventfabrics, Duro-Dyne (Adamson Company), Thermaflex or Frenzelit.

2.07 Duct Access Doors

- A. Furnish in ductwork as indicated and wherever necessary for proper access to all instruments, controls, fire dampers, motorized dampers and equipment and for convenient inspection, maintenance and replacement of same, size to be ample for usage. Openings shall be reinforced on all sides with material or ductwork in which doors are installed.

2.02 Volume Control Dampers

- A. Single blade (up to 6-inches high), multi-blade (over 6-inches high), control damper.
- B. Blades: Extruded aluminum airfoil shape with integral structural reinforcing tube running full length of each blade.
 - 1. At Points of Contact: Interlocking or overlapping edges, and compressible neoprene or extruded vinyl blade seals. In addition, hot and cold deck dampers, and dampers opening to the outside shall have compressible metal side seals.
 - 2. Except for Manual Balancing Application, Leakage when Closed: Less than 5 cfm per square foot for 48" x 48" damper size at 3-inch WG static pressure.
 - 3. Opposed blade type for balancing and modulating applications, parallel blade type for 2-position applications.
- C. Frames: 5 x 1 x 0.081-inch 6063-T5 extruded aluminum channel with mounting flanges on both sides of the frame. Each corner shall be reinforced with two die-formed internal braces and machine stacked for maximum rigidity.
- D. Bearings: Non-corrosive Molded Synthetic.
- E. Linkage: Linkage shall be concealed in frame.
- F. Axles: Axles shall be square or hexagonal to provide positive locking connection to blades and linkage.
- G. Manually operated dampers shall be provided with cadmium-plated steel quadrant with device for locking damper in position.
- H. Damper shall be equal to Ruskin Model CD40.

2.03 Backdraft Dampers

- A. Heavy duty damper with anti-leakage features, counter-balanced, parallel blade operation.
- B. Operating Linkage: Factory assembled, steel construction.
- C. Counterbalance Weight: Adjustable and mounted on the entering side. Not required on dampers located in ductwork on the discharge of fans.
- D. Frame: 16 gauge galvanized 3-1/2-inch channel with 7/8-inch double thickness flanges and corner bracing. Top and bottom stops and blade end seals shall be provided with galvanized angles spot welded to frame and sealed with sealer. Face of angles shall have replaceable, compressible polyurethane or neoprene seals.

- B. Two-piece pan construction, consisting of outer side crimped over inner dished side. Not less than two hinges and not less than two heavy cam latches. All contact surfaces of doors covered with heavy dense felt securely fastened in place to make doors air tight.
- C. Access doors to be insulated or soundproofed with same material as ducts or casings where located.
- D. Coordinate the location of access doors above inaccessible ceilings with the Engineer.

Part 3 Execution

3.01 Installation

- A. All ductwork accessories shall be installed in strict accordance with manufacturer's recommendations.
- B. Verify operation of dampers without binding of the linkage throughout entire operating range.
- C. Install flexible duct connectors with fabric in the midpoint of flexible range when in the static condition. Verify that full extension or compression is not reached in the operating mode.
- D. Verify duct access door installation allows adequate accessibility to the duct device intended for access.

END OF SECTION



Part 1 General

1.01 Scope

- A. Work specified in this Section is subject to the provisions of Section 15050.
- B. Furnish and install air outlets and inlets of the size, type, capacity, and characteristics described within the Contract Documents.

1.02 References

- A. The latest edition of the publications listed below are included as part of these Contract Documents.
 - 1. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) Standards
HVAC Duct Construction Standards
 - 2. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standards
ASHRAE 70 Methods of Testing for Rating the Performance of Outlets and Inlets
 - 3. Air Conditioning and Refrigeration Institute (ARI) Standards
ARI 650 Air Outlets and Inlets
 - 4. National Fire Protection Association (NFPA) Standards
NFPA 90A Installation of Air Conditioning and Ventilating Systems
 - 5. Air Movement and Control Associations (AMCA) Standards
AMCA 500 Test Method for Louvers, Dampers, and Shutters
 - 6. Air Diffusion Council (ADC) Standards
ADC 1062:GRD Test Code for Grilles, Registers, and Diffusers
 - 7. American Society for Testing and Materials (ASTM Standards)
ASTM E 90 Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

1.03 Submittals

- A. Submit shop drawings and product data in accordance with the provisions of Sections 01340 and 15050.
- B. Submit product data on all air inlets and outlets including actuators proposed for installation under this Section.
- C. Submit charts for color selection.
- D. Submit sound attenuation data for acoustical products and sound power data for all outlets.
- E. Submit airflow versus pressure drop performance data.
- F. Submit louver schedule indicating type and sizes to suit field verified wall openings.

Part 2 Products

2.01 Stationary Louvers

- A. Welded frame construction from extruded 6063T5 aluminum.
 - 1. Frames shall be box style.
 - 2. Frame depth shall be 6 -inches.
 - 3. Frame minimum thickness shall be 0.081-inch.
 - 4. Blade minimum thickness shall be 0.081-inch.
 - 5. Blades shall be drainable type.
 - 6. Provide with 0.081-inch thick extended sill.
 - 7. Provide continuous clip angle.
- B. Provide with continuous appearing stationary blades.
- C. Provide with Kynar 500 finish on all exposed surfaces, color selected by the Architect.
- D. Provide with stainless steel insect or bird screen as scheduled, mounted on interior side of louver.
- E. Acceptable Manufacturers: Equal to Ruskin Model ELF6375DX.

2.02 Combination Louvers

- A. Welded construction from extruded 6063T5 aluminum.
 - 1. Frames shall be box style.
 - 2. Frame depth shall be 6-inches.
 - 3. Frame minimum thickness shall be 0.081-inch.
 - 4. Stationary blade minimum thickness shall be 0.081-inch.
 - 5. Adjustable blade minimum thickness shall be 0.081-inch.
 - 6. Adjustable blade edge seal shall be vinyl.
 - 7. Adjustable blade pivot bearing shall be Nylon.
 - 8. Stationary blade shall be drainable type.
 - 9. Provide with 0.081-inch thick extended sill.
 - 10. Provide continuous clip angle.
- B. Provide with continuous appearing stationary blades.
- C. Provide with Kynar 500 finish on all exposed surfaces, color selected by the Architect.
- D. Provide with stainless steel insect or bird screen as scheduled, mounted on interior side of louver.
- E. Acceptable Manufacturers: Equal to Ruskin Model ELC6375DAX.

2.03 Grilles, Registers, and Diffusers

- A. Units shall be of the type, size and construction as scheduled on the Drawings.
- B. Unless otherwise noted on the Drawings, all units shall be supplied with a factory finish of white baked enamel.

Part 3 Execution

3.01 Louvers

- A. Louvers shall be installed according to the manufacturer's recommendations, and shall be caulked and sealed at the frame and flanges to make the installation weathertight.

- B. Combination louver dampers shall be installed with required damper operators and linkage mechanisms (furnished by louver/damper manufacturer) and shall be field adjusted for full opening/closure stroke. Louvers shall be interlocked with exhaust fans as scheduled on the Drawings and as described in Section 15950.

3.02 Grilles, Registers and Diffusers

- A. All units located in ceiling tiles shall be centered or shall be on quarter points of 2 x 4 foot tiles.
- B. Where a line of sight allows the ductwork, wall, or ceiling structure to be seen behind any units, such ductwork, wall, or ceiling structure shall be painted with non-flammable flat black paint to minimize visibility.
- C. All units not installed on T-bar ceiling grids shall be securely fastened to adjacent structures.
- D. Coordinate frame type with type of ceiling/wall to ensure proper installation.

END OF SECTION

Part 1 General

1.01 Scope

- A. All work specified in this Section is subject to the provisions of Section 15050.
- B. Furnish and install components and appurtenances required for the automatic control of each HVAC system or item. Automatic control system shall be complete with all devices required for a complete working system to attain the operating sequences specified or noted in the Contract Documents.
- C. All controls and control wiring shall be provided under this Division and installed according to Division 16 of these Specifications. Where control power is not available in the vicinity of mechanical equipment, a transformer shall be furnished and installed to convert power voltage to control voltage. The transformer may be an integral part of the starter.

1.02 References

- A. UL - Underwriters Laboratories, Inc.
- B. NEMA - National Electrical Manufacturers Association
- C. NEC - National Electrical Code
- D. NFPA - National Fire Protection Association
- E. ASME - American Society of Mechanical Engineers
- F. International Mechanical Code
- G. Local Codes and Ordinances

1.03 Electrical Coordination

Electrical work provided for HVAC automatic control systems under this Section, including materials and methods, shall be subject to the requirements of Division 16. Where work does not comply with the appropriate provisions of Division 16, the work shall be removed and replaced to comply with the Contract Documents at the expense of the Contractor. To ensure that proper materials are selected and suitable installation methods are used, provide all electrical work associated with HVAC controls under this Section in accordance with the requirements of Division 16.

1.04 Submittals

- A. Before ordering devices and components, submit sequences of operation, control diagrams and equipment descriptions for each system or item and obtain approval.

- B. Product Data: Manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions. Include panel construction details, controls, instruments, and labeling.
- C. Flow Diagrams: Schematic flow diagram of system showing heating and air conditioning equipment, fans, dampers, and control devices.
- D. Control Sequences: Sequences of operation shall be a narrative describing functions for start-stop, emergency shutdown, interlock, changeover and temperature-humidity control.
- E. Control Diagrams: Control diagrams shall show the power supply wiring, interlock circuit wiring, remote switch and thermostat wiring, emergency shutdown wiring, control devices, control device schedules and setpoints.
- F. Equipment descriptions shall comply with Section 15050.
- G. Provide maintenance procedures in accordance with Sections 01740 and 15050.

1.05 As-Built Drawings

At the conclusion of Work, correct control diagrams and sequences according to "as-built" conditions.

1.06 Instruction and Adjustment

- A. On completion of the job, the Contractor shall have completely adjusted the entire control system. The Contractor must demonstrate to the Owner that final calibrations and adjustments to the system are accurate
- B. The Contractor shall arrange to instruct the Owner's operating personnel on operation of the control system for a period of one day (at 8 hrs/day excluding travel time) and supply Owner with three copies of the control operating and instruction manuals. The Contractor shall obtain from the Owner's representative a signed receipt that Owner has received the instruction manuals and complete instruction on the operation of the system.

1.07 Warranty

The control system designated on Drawings and herein specified shall be warranted to be free from original defects in both material and workmanship for a period of one year of normal use and service. Damages arising from other uses shall be deemed the responsibility of the system owner. This warranty shall become effective starting the date the owner accepts the system.

Part 2 Products

2.01 Acceptable Manufacturers

The acceptable manufacturer's are: Johnson Controls, Inc., Staefa Control System, Honeywell.

2.02 Starters

Magnetic starters or combination starters as shown on the Drawings or specified herein, complete with running indication lights in an approved enclosure, shall be furnished and installed for mechanical equipment automatically started and stopped, or otherwise controlled by thermostats, timers, or other devices. Starters for all manually controlled equipment shall include running indication lights in an approved enclosure. Switches for starters shall be as shown on the Drawings or specified herein. All starters shall comply with the requirements of Section 16150.

2.03 Thermostats

A. Split or Packaged Air Conditioning Systems

1. Provide with switching subbase.
2. Mount 5'-0" AFF unless noted otherwise.

B. Fans and Heaters

1. Snap switches permanently sealed against corrosion.
2. Coiled copper tube sensing element.
3. Single Pull Double Throw.
4. 120 Degree F maximum operating temperature.
5. Equal to Honeywell T631C for NEMA 1, 3R and 12.
6. Equal to Honeywell T631F for NEMA 4X requirements.
7. Equal to Johnson Controls A19 Series for NEMA 7 and 9 requirements.
8. The control range of the thermostat shall be 35 to 100 degrees F, adjustable, unless noted otherwise.
9. Thermostats to be wired for close upon temperature rise for fans.

10. Thermostats to be wired for close upon temperature fall for heaters.
 11. Mount thermostats 5'-0" AFF unless noted otherwise.
- C. Integral Thermostats: Integral thermostats shall be heater manufacturer's standard item for heavy-duty operation and shall be factory installed.

2.04 Switches

- A. Switch enclosures to house indicating lights and selector switches. Indicating lights shall be light emitting diode (LED) type; incandescent lamps are acceptable.
- B. Selector switches to be factory sealed.
- C. Selector switches to be rated 600 VAC heavy-duty.
- D. Unused enclosure holes to be plugged with manufacturer's closure plug.
- E. Selector switches to be two or three position as required.
- F. Indicator plates to be marked as appropriate:
 1. OFF-AUTO
 2. START-STOP
 3. HAND-OFF-AUTO
- G. Equal to General Electric CR104P for standard requirements.
- H. Equal to Crouse-Hinds EFS/EFD for NEMA 7 and 9 requirements.
- I. Equal to Crouse-Hinds NCS for NEMA 4X requirements.
- J. Mount switches 5'-0" AFF unless noted otherwise.

2.05 Electric Actuators

Electric actuators shall be sized to operate their device with sufficient reserve power to provide smooth modulating or two-position action and tight close off.

2.06 Firestats

Firestats shall be 135 degree F, manual reset, line voltage type with bimetal actuated switches. Switch shall have an adequate rating for the applied load.

2.07 Freezestats

Freezestats shall be 40 degree F, manual reset, line voltage type. 15 foot (minimum) capillary shall be responsive to the coolest section of its length. Switch shall have an adequate rating for the applied load.

2.08 Solid State Speed Controllers

Solid state speed controllers shall be provided by fan manufacturer for fans as scheduled.

Part 3 Execution

3.01 Inspection

Examine areas and conditions under which electric control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 Installation of Electric Control Systems

- A. General. Install systems and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division-16 Sections of these specifications. Mount controllers at convenient locations and heights.
- B. Control Wiring. The term "control wiring" is defined to include provision of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices.
- C. Wiring System. Provide complete control wiring system for electric control systems. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.
- D. Number-code or color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system.

3.03 Adjusting and Cleaning

- A. Start-Up. Start-up, test, and adjust electric control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

- B. Cleaning. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
- C. Final Adjustment. After completion of installation, adjust thermostats, damper operators, motors and similar equipment provided as work of this Section. Final adjustment shall be performed by specially trained personnel in direct employ of the manufacturer of primary temperature control system.

3.04 Electric Unit Heaters

All electric unit heaters and wall heaters shall be controlled by their factory furnished integral thermostats or remote wall mounted thermostats as scheduled.

3.05 Fans

The following fan is a single phase fan. It is interlocked with Bathroom and Janitor Room lights. When lights in any one or both of these rooms are turned on, the fan shall run: MP-CHEM-EF-7.

3.06 Gas Fired Make-Up Air Units and Exhaust Fans (Continuous Ventilation Systems for Fire Code Requirement) (MP-CHEM-MAU-1, MP-CHEM-EF-1, 2, 3, and 6; MP-CHEM-MAU-2, MP-CHEM-EF-4 and 5)

- A. When exhaust fan's HOA switch is in HAND position, the fan shall run. When the switch is in OFF position, the fan shall be off. When the switch is in AUTO position, the exhaust fan shall be interlocked with its corresponding MAU.
- B. When the MAU is off, the exhaust fan interlocked to it shall be off. MAU supply fan and gas fired heater shall be de-energized.
- C. When the MAU is on:
 - 1. The MAU supply fan and the exhaust fans interlocked to the MAU shall run continuously.
 - 2. Gas fired heater in the MAU shall operate with its own factory furnished controls to maintain the space temperature.
 - 3. When the ventilation system emergency shut-off switch is in off position, the MAU and the fans interlocked to it shall be off.

3.07 Package Cooling Only AC Units (MP-CHEM-ACU-1; MP-CHEM-ACU-2)

- A. When the AC unit's ON-OFF switch is in OFF position, the AC unit shall be off.

- B. When the switch is in ON position, the AC unit shall operate with its own factory furnished controls to maintain space cooling temperature setpoint.
- C. When the AC system emergency shut-off switch (applies only to MP-CHEM-ACU-2) is in off position, the AC unit shall be off.

END OF SECTION

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Part 1 General

1.01 Scope

- A. All work specified in this Section is subject to the provisions of Section 15050.
- B. Total system balance shall be performed by an independent agency certified by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB). All work done by this agency shall be by qualified technicians under the direct supervision of an AABC or NEBB certified test and balance engineer.
- C. Total system balance shall be performed in accordance with the 4th edition of the AABC National Standards, 1982, for Total System Balance and in accordance with the scope of work defined by the Contract Documents.
- D. Total system balance shall not begin until all systems are complete.
- E. Upon the completion of the work, the test and balance agency shall submit four copies of the complete Test and Balance Report to the Engineer. Final test and balance report shall be required two weeks following completion of test and balance.
- F. One agency will be responsible for all phases of total system balance.
- G. The testing and balance agency as part of its contract shall act as an authorized inspection agency, and shall, during the test and balance, list systems that are installed incorrectly, require correction or have not been installed in accordance with Drawings and Specifications.
- H. The test and balance agency shall permanently mark the settings of all valves, dampers and other adjustment devices in a manner that will allow the settings to be restored. If a balancing device is provided with a memory stop, it shall be set and locked.

1.02 References

- A. Associated Air Balance Council (AABC) Standards: National Standards for Total System Balance
- B. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) Standards: HVAC Systems Testing, Adjusting and Balancing

1.03 Submittals

- A. The name of the test and balance agency, plus the name and registration number of the certified test and balance engineer, shall be submitted for approval within thirty days after the award of the Contract.

Testing, Adjusting, and Balancing

- B. The selected test and balance agency, plus the name and registration number of certified test and balance engineer, shall be submitted to the Engineer for approval within thirty days after the award of the Contract.
 - 1. Detailed procedures.
 - 2. Agenda.
 - 3. Report Forms.
 - 4. AABC National Project Performance Guaranty.
 - 5. Instrument List and Calibration Dates.
- C. A reviewed copy of each of the above listing shall be returned to the test and balance agency before total system balance is begun.
- D. If a complete submittal in accordance with Article 1.03, paragraph B. is not received within the specified time, the Engineer reserves the right to select the test and balance agency.

Part 2 Products (Not Used)

Part 3 Execution

3.01 Required Documents

The Contractor shall provide the following, in a timely fashion, to the test and balance agency: Contract Drawings and applicable Specifications; addenda; change orders; reviewed shop drawings; reviewed equipment manufacturer's submittal data; and reviewed temperature control drawings.

3.02 Cooperation

- A. The Contractor shall cooperate fully with the test and balance agency and provide:
 - 1. Completely operable systems.
 - 2. The right to adjust the systems.
 - 3. Access to system components.
 - 4. Immediate labor and tools to make corrections and repairs, when required, without undue delay.
 - 5. Balancing dampers as required by test and balance agency.

- B. The Contractor shall start-up and maintain all heating, ventilating and air conditioning systems and equipment into full operation and shall continue the operation of same during each working day of testing and balancing. Start-up shall include, as a minimum, the following:
1. All equipment operable in safe and normal conditions.
 2. Temperature control systems installed complete.
 3. Proper thermal overload protection in place for electrical equipment.
 4. Air Systems
 - a. Filters clean and in place.
 - b. Duct systems clean of debris.
 - c. Correct fan rotation.
 - d. Fire, smoke, and volume dampers in place and open.
 - e. Coil fins cleaned and combed.
 - f. Access doors closed and duct end caps in place.
 - g. All outlets installed and connected.
 - h. Duct systems leakage shall not exceed the rate specified.
- C. The external static pressure and RPMs of fans, MAUs, and AHUs as indicated in the equipment schedules on the Drawings are approximate. If it is determined by the test and balance agency that drive changes are required, the Contractor shall obtain and install all necessary components at no additional cost to the Owner.
- D. The Test and Balance Agency shall cooperate with the Engineer and the Contractor to perform the work in such a manner as to meet the job schedule.
- E. The test and balance agency shall leave all system components in proper working order, such as:
1. Replace belt guards.
 2. Close access doors.
 3. Close doors to electrical switch boxes.
 4. Restore thermostats to specified settings.
- F. All recorded data shall represent a true, actually measured or observed condition.

- G. Any abnormal conditions in the mechanical systems or conditions which prevent total system balance, as observed by the test and balance agency, shall be reported as quickly as possible to the Engineer.

END OF SECTION

Part 1 General

1.01 Scope

- A. The electrical work commences with the point of electrical service where shown on the Drawings and includes furnishing all material and labor for a complete electrical installation.
- B. The requirements of Division 1 apply to all work hereunder. The General and Special Conditions are a part of this Division of the Specifications and all provisions contained therein which affect this work are as binding as though incorporated herein.

1.02 Definitions

- A. Provide: Furnish, install, and connect.
- B. Product Data: Catalog cuts and descriptive literature.
- C. Shop Drawings: Factory prepared specific to the installation.
- D. Low Voltage: 0-600 volts.
- E. High Voltage: Above 600 volts.
- F. Indicated: Shown on the Drawings.
- G. Noted: Indicated or specified elsewhere.

1.03 Material Not Furnished

- A. Unless otherwise noted, the following are furnished and installed under other Divisions:
 - 1. Motors
 - 2. Motor starters (except motor control centers)
 - 3. Electric heating and air conditioning equipment
 - 4. Building energy management systems
 - 5. Electrical heat tracing
 - 6. Pilot and control devices for the above equipment
- B. Power wiring and equipment connections for the above items are included in this Division. Also included in this Division is control wiring to the extent shown on the Electrical Drawings; other control wiring is furnished under the applicable Mechanical

Division.

1.04 Local Conditions

- A. Power will be supplied from the Owner's existing distribution system. Provide feeders and connections to existing equipment as indicated on the Drawings. No power interruptions to existing equipment are permitted unless schedule for same has been approved by the Owner.
- B. Telephone and security will be tied into the Owner's existing system. Refer to the Drawings for conductors and interface requirements.

1.05 Quality Assurance

- A. Provide the complete electrical installation in accordance with the National Electrical Code (NFPA 70), Life Safety Code (NFPA 101), and in accordance with applicable local codes. Obtain all necessary permits and have all work inspected by appropriate authorities.
- B. All products shall be designed, manufactured, and tested in accordance with industry standards. Where applicable, products shall be labeled or listed by third party certification agencies.
- C. Industry Standards: Standards organizations and their abbreviations, as used herein, are as follows. Applicable date for industry standards is that in effect on the date of advertisement of the Project.
 - 1. American National Standards Institute (ANSI)
 - 2. American Society for Testing and Materials (ASTM)
 - 3. Federal Specifications (FS)
 - 4. Institute of Electrical and Electronics Engineers (IEEE)
 - 5. Insulated Cable Engineers Association (ICEA)
 - 6. National Electrical Manufacturers Association (NEMA)
 - 7. National Fire Protection Association (NFPA)
 - 8. Underwriters Laboratories, Inc. (UL)

1.06 Submittals

- A. Make all submittals in accordance with the requirements of Section 01340. Approval drawings consist of shop drawings, product data and other information as noted in the individual equipment sections. Except as noted, submittal information is for approval and equipment may not be installed until submittals have been returned with stamped

approval.

- B. Information required "for reference" such as product samples, similar unit test reports and time current curves is for the purpose of determining the suitability of a product, selecting breaker settings, etc. This information is to be submitted at the same time as approval data; however, this information will not be returned and stamped approval is not required prior to installation.
- C. Except as noted, installation instructions are not required to be submitted. However, it is the Contractor's responsibility to obtain installation information from the manufacturer for all equipment prior to installing the equipment.

1.07 Record Drawings

- A. Furnish record drawings in accordance with the requirements of Section 01720. Record drawings consist of submittal data as listed above, operation and maintenance data, and as-built drawings. Record drawings are to reflect the final installation, including any changes during approval, manufacturing tests, and installation.
- B. In addition to other required sets, furnish one set of operation and maintenance data for all apparatus requiring service. This set is to be bound in hardback, 3-ring binder(s) located in a hinged metal cabinet in the main electrical room and shall include:
 - 1. Title page with project name; installing contractor's name, address and telephone number; date of installation and warranty period.
 - 2. Index sheet.
 - 3. Complete manufacturer's operation and maintenance data with tabs (corresponding to the index) separating each item or system. Include the name, address, and phone number of the nearest sales and service organization for each item.
- C. As-Built Drawings: Furnish one set of prints maintained at the job site at all times with all changes during construction marked thereon. Include on the as-built drawings sufficient dimensions to permit location of underground conduits.
- D. Submit the results of any tests required in the individual equipment sections.

1.08 Delivery, Storage, and Handling

- A. Ship products to the job site in their original packaging. Receive and store products in a suitable manner to prevent damage or deterioration. Keep equipment upright at all times.
- B. Investigate the spaces through which equipment must pass to reach its final destination. Coordinate with the manufacturer to arrange delivery at the proper stage of construction and to provide shipping splits where necessary.

Part 2 Products

2.01 Materials

Provide only new products of the manufacturer's latest design.

2.02 Substitutions

- A. Where the words "equal to" follow or precede the listed acceptable manufacturers, equal products of other manufacturers are acceptable and request for substitution may be made during submittal stage.

Part 3 Execution

3.01 Installation

- A. The complete installation is to be accomplished by skilled electrical tradesmen, with certified or suitably qualified individuals performing all special systems installation and testing. All workmanship shall be of the highest quality, sub-standard work will be rejected.
- B. Schedule the work and cooperate with all trades to avoid delays, interferences, and unnecessary work. If any conflicts occur necessitating departures from the Drawings and Specifications, details of departures and reasons therefore shall be submitted immediately for the Engineer's consideration.
- C. Do not stub up conduits prior to receipt of approved shop drawings showing conduit entry locations.
- D. Prior to final inspection, clean all dirt, mud and construction debris from all boxes, cabinets, manholes and equipment enclosures.

3.02 Certification and Tests

- A. Prior to request for final review, test all systems and repair or replace all defective work. Submit, with request for final review, written certification that all electrical systems are complete and operational.
- B. At the time of final review of electrical work, demonstrate the operation of electrical systems. Furnish labor, apparatus and equipment for systems' demonstration.
- C. After final review and acceptance, turn over to the Owner all keys for electrical equipment locks. Present to the Owner or the Owner's designated representative, demonstrations and oral instructions for proper operation and maintenance of the electrical equipment and systems.

END OF SECTION

Part 1 General

1.01 Scope

- A. The electrical demolition work commences with the point where indicated on the Drawings and includes furnishing all equipment, materials and labor to accommodate new work.
- B. Scheduling: Coordinate all demolition and modification work with the requirements of Division 1 of these Specifications.
- C. Methods of demolition work shall provide for a safe conduct of work, and protection of property which is to remain in service and undisturbed.

1.02 Submittals

Submit to the Owner for review, a written detailed procedure and method for each structure to be demolished or modified. The submittal shall include approximate dates and times of deenergization of services.

Part 2 Products (Not Used)

Part 3 Execution

3.01 Demolition

- A. Coordinate and schedule all demolition work and outages of existing services prior to starting work.
- B. Existing services and facilities damaged or otherwise interrupted by the Contractor through negligence or through use of faulty materials or workmanship shall be promptly repaired, replaced, or otherwise restored by the Contractor without additional cost to the Owner.
- C. Interruptions of services necessary for connection to or modification of existing systems or facilities shall occur only at pre-arranged times approved by the Owner. Interruptions shall only occur after the provision of all necessary temporary work and the availability of adequate labor and materials has been assured that the duration of the interruption will not exceed the time agreed upon.
- D. Existing materials shall remain the property of the Owner and shall be stored at a location and in a manner as directed, or if classified by the Owner as unsuitable for further use, shall become the property of the Contractor and shall be removed from the site.
- E. All underground ductbank and conduits which are not in conflict with the new work shall be abandoned.

Electrical Demolition

- F. All exposed conduits in structures or buildings to be removed, shall be cut and plugged flush with structure or floor.
- G. All wiring to be removed shall be disconnected at distribution panels or MCC's. All wiring which serves equipment to be removed shall be removed.
- H. Schedule: Demolish electrical equipment from structures as indicated or as required to facilitate the installation of new equipment and work.
- I. All wiring, conduit or equipment designated on the Demolition Plan shall be disposed of in a safe manner in accordance with all applicable local, state and federal environmental agencies.

END OF SECTION

Part 1 General

1.01 Scope

- A. Rigid metal conduit and fittings.
- B. Liquidtight flexible metal conduit and fittings.
- C. Non-metallic conduit and fittings.

1.02 Submittals

Do not submit equipment specified in this Section.

Part 2 Products

2.01 Acceptable Manufacturers

- A. Conduit: Allied, Republic, Triangle or Wheatland.
- B. PVC Conduit: Amoco, Carlon or Certainteed.
- C. Flexible Conduit: Anaconda, Thomas & Betts, Electric Flex or Triangle.
- D. Fittings: Appleton, Crouse-Hinds, Oz or Thomas & Betts.
- E. Nonmetallic Flexible Conduit and Fittings: Carlon Carflex.
- F. Substitutions: Products equal to those listed.

2.02 Rigid Metal Conduit and Fittings

- A. Rigid Steel Conduit: UL 6; ANSI C80.1; hot dip galvanized; minimum size 3/4-inch.
- B. Rigid Aluminum Conduit: UL 6; ANSI C80.5; minimum size 3/4-inch.
- C. Fittings and Conduit Bodies: NEMA FB-1; zinc coated; taper-threaded type, material to match conduit.

2.03 Liquidtight Flexible Conduit and Fittings

- A. Conduit: UL listed liquidtight consisting of an extruded thermoplastic cover over a galvanized steel core. Minimum size 3/4-inch. Exception: Where connected to devices with manufacturer supplied 1/2 or 3/8-inch hubs, match conduit size to hub size.

Conduit

- B. Fittings and Conduit Bodies: NEMA FB-1; galvanized steel compression type with O-ring. Where PVC coated conduits are indicated, provide PVC coated fittings for flex connections.

2.04 Rigid Nonmetallic Conduit and Fittings

- A. Conduit: NEMA TC-2; Schedule 40 PVC. Exception: Use Schedule 80 PVC where exposed or direct bury.
- B. Fittings and Conduit Bodies: NEMA TC-3.

2.05 Liquidtight Flexible Non-Metallic Conduit and Fittings

- A. Conduit: UL listed, liquidtight consisting of a hard PVC spiral with flexible PVC covering. Minimum size is 3/4-inch.
- B. Fittings: UL listed, molded from high-strength, glass-filled thermoplastic.

Part 3 Execution

3.01 Conduit Schedule

- A. Except as noted, use the following conduits in the designated areas:

Area	Conduit Type
1. Chemical Bldg. Interior-Exposed	PVC Schedule 80
2. Chemical Bldg. Interior-Concealed	Rigid Steel
3. Underground	PVC Schedule 40 (concrete encased)
4. Exterior Exposed	Rigid Aluminum
5. Raw Water Transfer PS	Rigid Aluminum
6. Sludge Handling Electrical Room	Rigid Aluminum

- B. Use liquidtight flexible steel conduit for connections to motors, transformers and other vibrating equipment. Maximum length is 3 feet unless approved by the Engineer.
- C. Use PVC coated conduits where conduits are in direct contact with earth. Provide 24 inches minimum cover.
- D. Rigid nonmetallic conduit may be used for underground concrete encased duct banks and in or below slab on grade. Exception: Use rigid steel conduit for analog signal circuits; 4 to 20 mA and AC or DC signals less than 25 volts.
- E. Where PVC conduit is indicated, make a transition to rigid aluminum below grade or slab and continue above with rigid aluminum conduit. Exception: PVC may enter switchboards, motor control centers or other floor standing electrical equipment enclosures. Provide bell ends or socket end bell at enclosure entry.

3.02 Conduit Arrangement and Support

- A. Arrange conduit to maintain headroom and present a neat appearance. Run exposed conduits parallel or perpendicular to building surfaces and adjacent piping. Group conduit in parallel runs where practical and provide rack space for 25 percent additional conduits. Use concentric bends for parallel runs.
- B. Avoid sources of heat when possible. Where unavoidable, maintain 3-inch clearance when crossing hot pipes and 12-inch clearance between parallel hot pipes, flues, heating appliances and other heat sources.
- C. Support conduits to prevent distortion of alignment by wire pulling operations. Fasten single conduits with one hole malleable iron straps. For multiple runs use channel and clamps. Wire, perforated pipe straps and the like are not acceptable support means.
- D. Support conduit at a maximum of seven feet on center and within three feet of each box, cabinet, or fitting. Hang trapeze assemblies with threaded rods not less than 3/8-inch diameter. Remove all temporary supports prior to pulling conductors.
- E. Do not support conduits from electrical distribution equipment or control panels.

3.03 Conduit Installation

- A. Cut conduit square using a saw or pipecutter and de-burr cut ends. Paint threads with zinc compound. Bring conduit to the shoulder of fittings and couplings and fasten securely. All connections are to be wrench tightened and electrically continuous. No running threads are permitted.
- B. Use conduit hubs for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations. Use conduit bodies to make sharp changes in direction. For sizes 2-inches and larger, use "LBD" or similar fittings to permit a straight pull from either direction. In no case shall a fitting be used which results in bending radius too small for the cable.
- C. The maximum length between pull points is 400 feet. This length shall be reduced by one foot for each degree of bend.
- D. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2-inch size. Crushed or deformed conduits may not be installed.
- E. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- F. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture. Install threaded PVC end caps on conduits stubbed up for future use.
- G. Provide a 200 pound tensile strength polyolefin line pulled through and tied off at each end of all empty conduits.

Conduit

- H. Install expansion joints equal to Crouse Hinds type XJ where conduit crosses building expansion [or seismic] joints and for straight runs in excess of 100 feet. For seismic joints use expansion joints equal to Crouse Hinds type XD.
- I. Where conduit penetrates fire-rated walls and floors, provide mechanical fire-stop fittings with UL listed fire rating equal to wall or floor rating.
- J. Provide watertight seals, equal to OZ type WSK, FSK, or CSM, where conduit penetrates exterior walls and where conduit passes between spaces normally at different temperatures. Seal duct bank and underground conduit entry with GE or Dow silicone sealant. Stub duct bank and underground conduits up a minimum of 2-inches above equipment pads and provide bushing.
- K. Provide silicone sealant equal to Dow or GE for conduit entry in outlet boxes and equipment enclosures (all conduit ends except pull boxes and fittings) for the following areas:
 - 1. Caustic Soda
 - 2. Fluoride
 - 3. Sodium Hypochlorite
 - 4. Ferric Sulfate
 - 5. Polyaluminum Chloride
 - 6. Polymer
 - 7. Copper Sulfate
 - 8. Corrosion Inhibitor
- L. Obtain approved shop Drawings showing conduit entry space before stubbing conduits in floor standing electrical gear.
- M. In locations where the conduit cannot be turned, provide three piece threaded rigid couplings.
- N. Provide clamp backs for conduits on exterior or damp surfaces to prevent the raceway from bearing directly on the damp surface.
- O. Route conduits in slabs above grade above the bottom reinforcing and below the top reinforcing. Maximum size for conduits in slabs above grade is 1-inch. Route so conduits in slabs above grade do not cross. For slab on grade route conduits in a trench below slab at sufficient depth to permit vertical exit from slab. Home runs shall not be routed in slabs except where indicated.
- P. Protect conduit threads from rust and damage during construction.

- Q. PVC Conduit Bends: Do not use methods which will deform or change the physical characteristics of the conduit. Use PVC-coated rigid steel factory elbows for bends in runs longer than 100 feet, and in runs which have more than two bends, regardless of length. Exception: Where concrete encased in slab or ductbank, GRS elbows may be used in lieu of PVC coated.
- R. Wipe plastic conduit clean and dry before joining. Apply full even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.
- S. Conductor Protection: Provide bushings on metallic and bell ends on PVC conduits unless conduit terminates in a hub or similar fitting.

3.04 Underground Duct Bank Installation

- A. Install top of duct bank minimum 18-inches below finished grade with plastic warning tape 12-inches below finished grade.
- B. Install conduit with minimum grade of 4-inches per 100 feet.
- C. Terminate conduit in end bell at manhole entries.
- D. Stagger conduit joints in concrete encasement 6-inches minimum.
- E. Provide minimum 3-inch concrete cover at bottom, top, and sides of duct bank. Use suitable separators and chairs installed not greater than four feet on centers to provide conduit spacing as indicated. Securely anchor conduit to prevent movement during concrete placement.
- F. Construct duct banks with 3,000 psi concrete. Provide reinforcing as indicated.
- G. Where duct bank passes beneath footings or slabs resting on grade excavate to provide a minimum of 6-inch clearance between the conduits and the structure. Backfill to the base of the structure with concrete.

END OF SECTION



Part 1 General

1.01 Scope

- A. Building wire.
- B. Cable.
- C. Wiring connections and terminations.

1.02 Submittals

- A. Submit product data.

Part 2 Products

2.01 Acceptable Manufacturers

- A. Low Voltage Conductors: Equal to Aetna, American, Cablec, Continental, Okonite, Pirelli, Southwire or Triangle.
- B. Signal Circuit Conductors: Equal to Belden, Continental, Dekoron or Penn.
- C. Low Voltage Connectors: Equal to Burndy, Thomas & Betts, Ideal or OZ.
- D. Pulling Compounds: Water soluble, equal to Polywater J.
- E. Wire and Cable Markers: Plastic, split sleeve or tubing type, equal to Brady Type XC or T & B Type SM.

2.02 Building Wire

- A. Thermoplastic Insulated Building Wire: NEMA WC-5.
- B. Feeder and Branch Circuits: Single conductor; 98 percent conductivity copper; 75/90 degrees C; 600 volt PVC insulated with nylon jacket; Type THWN/THHN. Minimum size #12 AWG.
- C. Control Circuits: Same as specified above for feeder and branch circuits, except minimum size #14 AWG.

2.03 VFD Cables

VFD Cables: Stranded copped conductors, 100% shielding with foil tape and copper tape, oil and chemical resistant outer jacket, specifically designed for use with variable frequency drives. Cables are 4 conductor plus 2 – No. 14 signal conductors in sizes No. 12 AWG to No. 4 AWG and 4 conductor in sizes No. 2 AWG and larger. Equal to Olflex – VFD.

2.04 Remote Control and Signal Cable

- A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor; 600 volt insulation, rated 60 degrees C; individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.
- B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60 degrees C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.
- C. Instrumentation Signal Cables: #16 AWG stranded tinned copper conductors; 600 volt polyethylene insulation; twisted pair or three conductor construction; 100 percent coverage aluminum polyester shield; #18 stranded tinned copper drain wire; vinyl outer jacket; UL listed.

Part 3 Execution

3.01 General Wiring Methods

- A. Use only stranded conductors. Exception: Solid conductors size #12 and #10 AWG may be used for receptacle branch circuit wiring. Solid conductors may also be used for supervised fire alarm circuits.
- B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.
- C. Place an equal number of conductors for each phase of a circuit in same raceway or cable.
- D. Identification: All conductors shall be identified throughout the electrical system. For control and signal conductors use wiremarkers at all terminals and connections. Color code power circuit conductors as follows:

	120/208 Volt System	277/480 Volt System
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Grey
Ground	Green	Green

- E. For conductors larger than #6 AWG color coding may be accomplished with 1-inch wide colored tape applied at each end of the conductor or at points where conductor is accessible so as to be visible inside the enclosure.

- F. Neatly train and lace wiring inside boxes, equipment and panelboards. Support to prevent conductor movement under fault conditions.

3.02 Wiring Installation in Raceways

- A. Unless otherwise indicated, install all conductors in conduit.
- B. Pull all conductors into a raceway at the same time. Thoroughly swab raceway system before installing conductors. Use wire pulling lubricant for all pulls. Do not exceed the manufacturer's pulling tension.
- C. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

3.03 Installation in Manholes

- A. Rack all cables; straight thru pulls are not acceptable.
- B. Secure cables to rack supports with tie wraps to prevent motion under fault conditions.
- C. Make a minimum 360° circuit of manholes with high voltage cables.

3.04 Wiring Connections and Terminations

- A. Avoid unnecessary splices. Splice only in accessible junction or outlet boxes.
- B. Make connections to circuit breakers, disconnect switches, panel mains, etc. with solderless lugs.
- C. Use mechanical connectors for splices, taps, fixture and motor connections. Exception: Square thread helical spring plastic cap (wire nut) type connectors are acceptable for solid conductor splices and taps.
- D. Use insulated throat, spade type crimp on connectors for strap screw device terminals. Exception: Receptacle back wiring provisions may be used for terminating solid conductors.
- E. Where possible use connectors with integral, insulating covers. Otherwise tape uninsulated conductors and connectors to 150 percent of the insulation value of conductor.
- F. Thoroughly clean wires before installing lugs and connectors.
- G. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

3.05 Field Quality Control

- A. Inspect wire and cable for physical damage and proper connection.
- B. Torque test conductor connections and terminations to manufacturer's recommended values.
- C. Continuity Tests: Ring all conductors for continuity and replace any open conductors.
- D. Ground Fault Tests: Meggar all feeder circuits for grounds. Compile and submit a list of meggar readings. Replace all conductors measuring less than 2 megohms to ground.

END OF SECTION

Part 1 General

1.01 Scope

- A. Outlet boxes.
- B. Pull and junction boxes.

1.02 Submittals

Submit product data.

Part 2 Products

2.01 Acceptable Manufacturers

Boxes shall be equal to Appleton, Crouse Hinds, Hoffman, Raco, or Steel City.

2.02 Outlet Boxes

- A. Sheet Metal Outlet Boxes: NEMA OS-1; galvanized steel, with 1/2-inch male fixture studs where required.
- B. Nonmetallic Outlet Boxes: NEMA OS-2.
- C. Cast Boxes: Material to match conduit; aluminum or cast ferrous alloy with galvanized or cadmium finish, deep type, gasketed cover, threaded hubs.

2.03 Pull and Junction Boxes

- A. Sheet Metal Boxes: NEMA OS-1; galvanized steel. Boxes larger than 12-inches in any dimension shall be hinged enclosure.
- B. Cast Metal Boxes: NEMA 250; Type 4, galvanized cast iron box and cover, neoprene gasket, stainless steel cover screws, UL listed as raintight. Provide flat-flanged type for surface mounting and outside flange recessed cover type for underground use. Boxes for sidewalk or other traffic areas to have appropriate duty cover with non-skid finish.
- C. Corrosion Resistant Boxes: UL 508 Type 4X non-metallic fiberglass reinforced polyester, gasketed screw cover. For boxes larger than 12-inches in any dimension provide hinge on one side and stainless steel toggle latches (equal to Hoffman A-FC4-12SS) on the other three sides. Equal to Crouse Hinds Krydon type NJB.
- D. Fiberglass Handholes for Underground Installations: Die-molded with pre-cut 6 x 6-inch cable entrance at center bottom of each side; fiberglass weatherproof cover with non-skid finish.

2.04 Wireways

Wireways shall be 14 gauge steel minimum, hinged cover and body, NEMA 12, grey powder finish inside and out.

Part 3 Execution

3.01 Coordination of Box Locations

- A. Provide boxes as shown on Drawings, and as required for splices, taps, wire pulling, and equipment connections.
- B. Box locations shown on the Drawings are approximate unless dimensioned. Verify box locations prior to rough-in. Coordinate mounting heights and locations of outlets mounted above counters, benches, backsplashes, and other furnishings. Locate outlet boxes to permit handicap access per ANSI A117.1. Any outlet may be relocated by up to 10 feet before it is permanently installed without incurring additional cost.

3.02 Installation

- A. Do not install boxes back-to-back in walls. Provide minimum 6-inch separation, except provide minimum 24-inch separation in acoustic-rated walls.
- B. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.
- C. Support boxes independently of conduit. Provide knockout closures for unused openings.
- D. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- E. In inaccessible ceiling areas, position outlets and junction boxes within 6-inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- F. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- G. Align wall-mounted outlet boxes for switches, thermostats, and similar devices. Align adjacent devices at different elevations in one vertical line. Set floor boxes level and flush with finish flooring material.
- H. Unless otherwise noted, use only cast boxes. Sheet metal boxes may be used where concealed above ceilings or in dry walls, exposed in electrical closets, and for

telephone wiring.

- I. Field drill conduit holes in tap, junction and pull boxes so as to afford the maximum bending radius for the conductors.
- J. Label cover of junction boxes with circuit numbers of conductors in the box.

END OF SECTION

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Part 1 General

1.01 Scope

- A. Wall switches.
- B. Receptacles.
- C. Device plates and box covers.

1.02 Submittals

Submit product data.

Part 2 Products

2.01 Acceptable Manufacturers

- A. Switches and Receptacles: Equal to Arrow Hart, Bryant, GE, Hubbell, Leviton SpecMaster, Pass and Seymour or Sierra.

2.02 Switches and Receptacles

- A. Wall Switches: NEMA WD-1; FS W-S-896; 20 amp, 120/277 volt, specification grade; horsepower rated; quiet type; back and side wiring provisions; toggle handle.
- B. Convenience Receptacles: NEMA WD-1; FS W-C-596; 15 amp, 125 volt, specification grade; impact resistant nylon face; back and side wiring provisions; grounding screw.
- C. Specific Use Receptacles: NEMA WD-1 or WD-5; type as indicated. For branch circuits serving a single device, match device rating to branch circuit rating.
- D. Device Colors: Gray, brown or black for specific use devices, otherwise as selected by the Engineer.

2.03 Wall Plates

- A. Decorative Cover Plates: Unbreakable nylon, Lexan, or noryl, smooth finish, color to match devices.
- B. Unfinished Area Device Plates: Type 302 stainless steel, 0.030-inch thick minimum, satin finish.
- C. Weatherproof (NEMA 3R and NEMA 4X) Cover Plates: Stainless steel, specification grade, gasketed equal to Sierra WP Series. For heat tape, instruments, or other devices which are continuously plugged in, provide die cast aluminum, suitable for wet

locations while in use, equal to Hubbell WP26.

Part 3 Execution

3.01 Installation

- A. Secure devices to outlet boxes without depending on device plates to pull them tight. Install a bonding jumper between all devices and outlet boxes.
- B. Install switches with off position down; and receptacles with grounding pole on bottom.
- C. For cord and plug connected equipment, coordinate receptacle configuration with equipment supplied.
- D. Corridor Convenience Receptacles: Hospital grade.
- E. Install device plates on switch, receptacle, and blank outlets. Use jumbo size plates for devices installed in masonry walls.

END OF SECTION

Part 1 General

1.01 Scope

- A. Squirrel cage induction motors.

1.02 Related Work

All motor driven equipment sections except hermetic refrigerant motor-compressors and submersible motors.

1.03 Work Specified Elsewhere

Except as noted, equipment specified in this Section is provided under other Divisions. Include, under this Section, receiving, storage, handling and wiring.

1.04 Quality Assurance

- A. Equipment Standards: NEMA MG-1.
- B. Efficiency: Premium design; guaranteed minimum values determined in accordance with IEEE Standard 112, Test Method B including stray load loss as follows:

HP	Synchronous RPM			
	3,600	1,800	1,200	900 & Less
20 - 49	91%	92.4%	92.4%	90.2%
50 - 99	92.4%	93.6%	93%	93%
100 & Above	94.1%	95%	94.1%	93%

- C. For motors rated 1 to 19 HP, provide efficiency in accordance with ASHRAE Standard 90.1 - 1989, Table 5-1.

1.05 Submittals

- A. Submit shop drawings showing certified dimensions and nameplate data.
- B. Submit expected and guaranteed minimum efficiency values for operation at 100, 75, 50 and 25 percent load.

Part 2 Products

2.01 Acceptable Manufacturers

Motors shall be manufactured by General Electric, Reliance, Toshiba, Siemens.

2.02 Ratings

- A. Horsepower (HP): As noted. Where no value is noted, match the requirements of the driven equipment.
- B. Phase
 - 1. Less than 1/2 HP: Single phase.
 - 2. 1/2 HP and Larger: Three phase.
- C. Voltage
 - 1. Single Phase Motors: 115/200/230 volt reconnectable. Exception: Single voltage motors will be permitted if the voltage matches the supply characteristics shown on the Electrical Drawings.
 - 2. Three-Phase Motors: 200/230/460 volt reconnectable. Exception: Single voltage motors will be permitted if the voltage matches the supply characteristics shown on the Electrical Drawings.
- D. Speed, Revolutions Per Minute (RPM): As noted. Where no value is noted, match the requirements of the driven equipment.
- E. Torque and Starting Current: NEMA design B unless otherwise noted. Exceptions: Provide NEMA design C or D where required by the driven equipment. Unless specifically noted NEMA design A motors are not acceptable.
- F. Service Factor: 1.15. Exception: See below for inverter-fed motors.
- G. Insulation and Temperature Rise: Except as noted, Class B or Class F insulation with temperature rise, measured by resistance, corresponding to the insulation class in accordance with NEMA standards for operation in a 40 degree C ambient. Exception: See below for inverter-fed motors.

2.03 Construction

- A. Enclosure: Totally enclosed fan cooled (TEFC) unless otherwise noted.

- B. Windings: Copper. Exception: Aluminum windings are acceptable where the aluminum to copper transition is done by the manufacturer with copper leads brought out to the motor conduit box.
- C. Bearings: Minimum 100,000 hours for direct coupled and 40,000 hours for belted applications B-10 life rating per AFBMA standards.
- D. Multispeed Motors: Two-winding type.
- E. Starting: Suitable for full voltage starting.

2.04 Accessories

- A. Provide lifting eyes for 182 and larger frame size. Provide oversized conduit box for 250 and larger frame size.
- B. Where noted provide normally closed thermostat for winding protection.
- C. Where noted provide 120 volt, single phase space heater. Size heater to increase motor temperature approximately 10 degrees C above ambient.
- D. Nameplate: Permanently affixed and stamped so as to permit recovery of the nameplate data in the event the nameplate is painted over.

2.05 Inverter-Fed Motors

- A. Equipment Standards: Inverter duty and in accordance with NEMA MG-1, Part 31, "Definite-Purpose Inverter-Fed Motors". Usual service conditions per MG-1 31.10.2 apply unless otherwise noted.
- B. Service Factor: 1.0.
- C. Insulation and Temperature Rise: Class F insulation with temperature rise in accordance with Class B limits.
- D. Peak Voltage and Rise Time: In accordance with MG-1 31.40.4.2.
- E. Provide shaft grounding or insulated bearings for motors larger than 320 frame size. If insulated bearings are used, provide insulated coupling if the driven equipment bearings are susceptible to damage by current flow.

Part 3 Execution

3.01 Installation

- A. Verify clearances and alignment prior to operation.

Motors

- B. Lubricate in accordance with the manufacturer's instructions.
- C. Check rotation and correct as necessary.

END OF SECTION

Part 1 General

1.01 Scope

- A. Conduit and equipment supports.
- B. Fastening hardware.

1.02 Submittals

Do not submit equipment specified in this Section.

Part 2 Products

2.01 Acceptable Manufacturers

Prefabricated structural systems shall be equal to B-Line Systems, Kindorf, Powerstrut or Unistrut.

2.02 Material

- A. Support Channel: Fiberglass or stainless steel.
- B. Hardware: Corrosion resistant.
- C. Threaded Rods: 3/8-inch diameter, stainless steel.

Part 3 Execution

3.01 Installation

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, preset inserts or beam clamps.
- B. Use expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces.
- C. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- D. Do not use powder-actuated anchors.
- E. Do not use perforated straps or wire.
- F. Make all supports from the structure, not the work of other trades. Do not drill structural steel members. Install supports so as not to weaken the structure.

Supporting Devices

- G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- H. Install free-standing electrical equipment on concrete pads.
- I. Install surface-mounted cabinets and panelboards on channel with minimum of four anchors.

END OF SECTION

Part 1 General

1.01 Scope

- A. Nameplates.
- B. Wire and cable markers.
- C. Color coding.

1.02 Submittals

- A. Submit product data.
- B. Include schedule for nameplates and tape labels.

Part 2 Products

2.01 Materials

- A. Nameplates: Engraved three-layer laminated plastic, black letters on a white background.
- B. Wire and Cable Markers: Split sleeve or tubing type, plastic, equal to Brady Type XC or T & B Type SM.

Part 3 Execution

3.01 Installation

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Secure nameplates to equipment fronts using screws or rivets. Secure nameplate to inside face of recessed panelboard doors in finished locations. Exception: Two-part epoxy glue may be used for NEMA 4/4X enclosures.

3.02 Wire Identification

Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams for control wiring.

3.03 Nameplate Engraving Schedule

- A. Provide nameplates to identify all electrical distribution and control equipment, and loads served. Letter height: 1/8-inch for individual switches and loads served, 1/4-inch for distribution and control equipment identification.
- B. Panelboards, Switchboards and Motor Control Centers: 1/4-inch; identify equipment designation; 1/8-inch; identify voltage rating and source.
- C. Transformers: 1/4-inch; identify equipment designation; 1/8-inch; identify primary and secondary voltages, primary source, and secondary load and location.
- D. Switches and Receptacles: Where indicated provide nameplates with 1/8-inch letters.

3.04 Color Coding

Fire Alarm System Junction/Pull Boxes: Red

END OF SECTION

Part 1 General

1.01 Scope

- A. 400A Automatic transfer switch at MPTP existing electrical building.
- B. 800A Manual transfer switch at RWTS, UL Listed for service entrance.

1.02 System Description

- A. Each system consists of a double throw, electrically operated switch to automatically or manually transfer and re-transfer load to and from a standby power source.
- B. When voltage on any phase drops below 85 percent of normal for a time period of three seconds, a set of contacts close. Automatic transfer occurs when voltage and frequency on the emergency source have reached 95 percent of normal.
- C. Automatic re-transfer to normal occurs when the normal source has reached 95 percent of normal voltage for a period of 20 minutes. However, should the emergency source fail during the 20 minute timing period, re-transfer shall occur immediately.
- D. After re-transfer the engine start contacts shall remain closed for a five minute cool down period.

1.03 Quality Assurance

Provide switches conforming to NEMA ICS-2-447 and UL 1008.

1.04 Submittals

Shop Drawings: Include dimensions, complete ratings, and sequence of operation.

1.05 Record Drawings

- A. Shop Drawings: As listed under Article 1.04 above, corrected to reflect the equipment as-built.
- B. Operation and Maintenance Data: Include recommended maintenance procedures and intervals, spare parts listing and instruction books for all components.

Part 2 Products

2.01 Acceptable Manufacturers

Transfer switches shall be manufactured by Russelectric or Zenith.

2.02 Ratings

- A. Continuous Current Rating: As indicated on the Drawings.
- B. Short Circuit: Withstand ratings when used with molded case circuit breakers are as follows:

Switch Size	Withstand RMS Symmetrical Amps
100 - 399	14,000
400 - 999	35,000
1000 - up	50,000

2.03 Transfer Switch

- A. Switch Mechanism: Double throw type interlocked mechanically and electrically to prevent simultaneous closing. Transfer switches consisting of interlocked circuit breakers or molded case switches will not be acceptable.
- B. Enclosure: As indicated.
- C. Controls: Arrange so that all components are accessible from the front without major disassembly or disconnecting power conductors. Provide normal and emergency position indication lights on the front of the enclosure and dry contacts (in addition to engine start contacts) for remote position indication. Provide adjustments for all voltage and transfer time delays, and a test switch to simulate normal source failure.
- D. Provide a UL listed manual operator to permit operation under load without opening the enclosure door.

Part 3 Execution

3.01 Installation

Install in accordance with the manufacturer's instructions. Verify available floor/wall space and conduit entrances prior to installation.

3.02 Tests

- A. Adjust voltage and transfer time settings to the values listed above in Article 1.02.
- B. Functionally test the completed installation by tripping the utility source main breaker. The Engineer reserves the right to witness this test and 10 days notice shall be provided.

END OF SECTION

Part 1 General

1.01 Scope

Pad mounted transformers.

1.02 Quality Assurance

- A. Equipment Standards: ANSI C57.12.
- B. Perform standard commercial tests in accordance with ANSI C57.12.90.

1.03 Submittals

- A. Submit shop drawings.
- B. Include complete ratings and dimensions, nameplate diagram, connection and arrangement, and accessories.

Part 2 Products

2.01 Acceptable Manufacturers

Transformers shall be manufactured by ABB, General Electric, R.T.E., or Square D.

2.02 Rating

- A. KVA: As indicated; three phase, 60 Hertz.
- B. Voltage: As indicated, delta connected on the primary and wye connected secondary.
- C. BIL: 95 kV for 12470 volt primary.
- D. Impedance: Manufacturer's standard 4 percent minimum for units rated 300-500 KVA.
- E. Temperature Rise: 65 degrees C.

2.03 Construction

- A. Transformer: Self-cooled, oil filled, compartmental-type consisting of transformer tank, primary, and secondary cable terminal compartments all assembled as an integral unit for mounting on a concrete pad.
- B. Tank: Sealed construction with welded main cover, and bolted tamper resistant handhole for access to internal connections. Fill tank with insulating oil.

Pad Mounted Transformers

- C. Terminal Compartments: Full height, air filled, located side by side, separated by a steel barrier, with the incoming compartment on the left. Provide individual hinged doors with padlocking provisions. Include fastening means for primary compartment door which is accessible only through the secondary compartment.
- D. Enclosure: Sheet steel on a structural steel frame with provisions for lifting, skidding and rolling. Enclosure shall be weatherproof and tamper proof with no exposed screws, bolts, or other fastening devices which are externally removable. Clean all steel surfaces and finish in dark green enamel over a rust inhibitor.

2.04 Terminations

- A. Primary: Dead front, radial feed with three 200 amp loadbreak integrated bushings.
- B. Switching: Two position, oil-immersed, gang operated, 200 amp, load break radial feed switch. Switch handle to be located in the primary compartment and suitable for hot stick operation.
- C. Overcurrent Protection: Three current limiting fuses rated 50,000 amps asymmetrical interrupting capacity, mounted in a loadbreak, dry-well fuse holder.
- D. Secondary: Tinned, spade type bushings with NEMA standard drilling.

2.05 Accessories

- A. Diagrammatic nameplate located in the primary compartment and readable with cables in place.
- B. Taps: Four; 2-1/2 percent; full capacity; two above and two below rated primary voltage. Tap changer to be located in the primary compartment suitable for no load, hot stick operation.
- C. Standard accessories including 1-inch drain and sampling valve, dial type thermometer, liquid level gage, 1/4-inch NPT provisions for vacuum/pressure gauge.

Part 3 Execution

3.01 Installation

- A. Install in accordance with the manufacturer's instructions. Modify existing concrete pad as required to accommodate new transformer.
- B. Ground in accordance with Section 16455.

3.02 Tests

- A. Verify phasing.

- B. Measure secondary voltage under normal load conditions and adjust taps as required to provide rated secondary voltage.

END OF SECTION



Part 1 General

1.01 Scope

Distribution switchboards.

1.02 Submittals

Shop Drawings: Front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and equipment short circuit rating.

1.03 Record Drawings

- A. Shop Drawings: As listed in Article 1.02, corrected to reflect the equipment as-built.
- B. Operation and Maintenance Data: Spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.04 Delivery, Storage and Handling

- A. Arrange shipping splits as required for installation. Individually wrap each section and mount on shipping skids.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with NEMA PB-2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

Part 2 Products

2.01 Acceptable Manufacturers

Switchboards shall be manufactured by General Electric, Square D, Cutler-Hammer, or Siemens.

2.02 Switchboard Construction and Ratings (MDP-RW, MDP-CHEM)

- A. Switchboard: Factory-assembled; dead front; metal-enclosed; front accessible; self-supporting switchboard assembly conforming to NEMA PB-2; complete from

Switchboards

incoming line terminals to load-side terminations.

- B. Switchboard Electrical Ratings and Configurations: As indicated.
- C. Main Section Device: Individually mounted.
- D. Distribution Section Devices: Panel mounted.
- E. Bus: Copper, sized in accordance with NEMA PB-2. Provide a copper ground bus through the length of the switchboard.
- F. Enclosure: NEMA PB-2 Type 1 - General Purpose. Sections align at the rear for mounting against a wall.
- G. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.
- H. Surge Protection: Provide transient voltage surge suppressor, UL listed in accordance with UL 1449 (2nd Edition); suitable for high exposure level ANSI/IEEE C62.41 Cat. C3 environments; total surge current shall not be less than 120 kA per phase or 60 kA per mode in accordance with NEMA LS-1. Provide surge suppressor with standard overcurrent protection, integral disconnect and diagnostic indicating lights. Suppressor shall be installed in the switchboard on the load side of the main disconnect device, as close as possible to the phase/neutral/ground conductors per manufacturer's recommendations.

2.03 Switching and Overcurrent Protective Devices

- A. Molded Case Circuit Breakers: NEMA AB-1; FS W-C-375; provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.
- B. Current Limiting Molded Case Circuit Breakers: NEMA AB-1; FS W-C-375; 100,000 AIC; let-thru current and energy no higher than permitted for same size Class K-5 fuse. Provide molded case circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole.
- C. Main Circuit Breaker: NEMA AB-1; FS W-C-375; integral solid state trip device with adjustable pick up and time delay settings for long time, short time, and ground fault.

2.04 Instruments and Sensors (MDP-RW, MDP-CHEM)

- A. Circuit Monitor: Microprocessor based unit for measuring multiphase variables including amps, volts, VARS, watts, volt-amps, power factor, demand values and harmonic distortion indication. Communications: ModBus RTU protocol; digital and analog inputs and outputs; RS232 port on front; RS485 ports on rear. Equal to General Electric Power Quality Meter.

- B. Current Transformers: ANSI C57.13; 5 ampere secondary, bar or window type, with single secondary winding and secondary shorting device, primary/secondary ratio as required, burden an accuracy consistent with connected metering and relay devices, 60 Hertz.
- C. Potential Transformers: ANSI C57.13; 120 volt single secondary, disconnecting type with integral fuse mountings, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

Part 3 Execution

3.01 Installation

- A. Install switchboard in locations shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB-2.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.

3.02 Field Quality Control

- A. Inspect completed installation for physical damage, proper alignment, anchorage and grounding.
- B. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute each. Test voltage shall be 1,000 volts, and minimum acceptable value for insulation resistance is 2 megohms.
- C. Check tightness of accessible bolted bus joints using a calibrated torque wrench. Tightness shall be in accordance with manufacturer's recommended values.
- D. Touch up scratched or marred surfaces to match original finish.

END OF SECTION



Part 1 General

1.01 Scope

- A. Disconnect switches.
- B. Fuses.
- C. Enclosures.

1.02 Submittals

Submit product data. Include outline drawings with dimensions, and equipment ratings for voltage, capacity, horsepower and short circuit.

Part 2 Products

2.01 Acceptable Manufacturers

- A. Disconnect Switches: Equal to General Electric, Siemens, Square D, or Cutler-Hammer.
- B. Fuses: Equal to Bussmann, Chase-Shawmut or Littlefuse.

2.02 Disconnect Switches

- A. Fusible Switch Assemblies: NEMA KS-1; FS W-S-865; quick-make, quick-break, 600 volt heavy duty load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: FS W-F-870; designed to accommodate Class R fuses.
- B. Nonfusible Switch Assemblies: NEMA KS 1; FS W-S-865; quick-make, quick-break, 600 volt heavy duty load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Enclosures: Stainless steel or Glass reinforced polyester meeting NEMA 4X requirements.

2.03 Fuses

- A. Fuses 600 Amperes and Less: As indicated: dual element, current limiting, time delay, one-time fuse, 600 volt.
- B. Interrupting Rating: 200,000 rms amperes.

Part 3 Execution

3.01 Installation

- A. Provide switches with voltage, ampere, and number of poles as indicated on the Drawings.
- B. Switches are non-fused type, unless Drawings note otherwise, or the switch is used as a disconnect for an item of equipment with a maximum fuse size designated on the nameplate. In such cases, provide fusible type with appropriate fuse. If fusible switches protect conductors with an ampacity less than the rating of the switch, provide a nameplate on the inside front cover of the switch designating the maximum allowable fusing.
- C. Install switches so they are rigidly supported and readily accessible. Where mounted on stud walls, provide a plywood backboard secured to the studs with the switch secured to the backboard. Provide stainless steel mounting channel or phenolic spacers to give nominal 1/2-inch separation from concrete walls in wet or damp locations.
- D. For disconnect switches serving motors with space heaters, provide lamecoid nameplate engraved "WARNING - Motor space heater energized with switch open".

END OF SECTION

Part 1 General

1.01 Scope

- A. Power system grounding.
- B. Communication system grounding.
- C. Electrical equipment and raceway grounding and bonding.

1.02 System Description

- A. The system consists of a ground grid for building grounding; ground clusters for supplemental electrodes; and connections thereto of structures, equipment and electrical systems.
- B. This Section is intended to supplement the requirements of the NEC, particularly Article 250, and to differentiate among options allowed by the NEC. This Section is not intended to reiterate explicit requirements of the NEC.
- C. Within this Section the following definitions apply:
 - 1. Ground Cluster: An assembly of three or more driven ground rods; spaced not closer than eight feet apart; each rod connected to the others in a closed delta configuration; and providing a resistance to ground of not more than 10 ohms.
 - 2. Connect or Bond: For underground or otherwise inaccessible locations - a permanent connection made by exothermic welding, brazing, or similar process. For exposed and accessible locations - a connection made with clamps, bolts or similar fittings approved for the purpose.

1.03 Submittals

- A. Submit product data.

Part 2 Products

2.01 Materials

- A. Bare Conductors: ASTM B-8; stranded; hard drawn copper. Size unless otherwise noted is #4/0 AWG.
- B. Ground Rods: UL 425H; 5/8-inch x 8 feet; high strength steel core with metallurgically bonded copper jacket.

Part 3 Execution

3.01 Installation

- A. Except as noted, use insulated ground conductors only where installed in a raceway. Use bare conductors for the ground grid, ground rod connections, and bonding of buildings, structures etc. Where a bare conductor is installed in a raceway use only non-metallic raceways; do not install bare conductors in metallic raceways.
- B. Drive ground rods so the top is 3 to 6-inches below finished grade. If rock is encountered then rods may be driven at an angle or grounding plates, as approved by the Engineer, may be used.
- C. Construct ground clusters as follows: Start with three driven ground rods and measure the resistance to ground of each rod. If the parallel combination exceeds 10 ohms then add sections and drive the rods deeper, or drive additional rods until the specified value is obtained. Connect each rod to every other rod in the cluster. Exception: not more than three additional rods or sections (six total) are required for any one cluster.
- D. Where bare conductors emerge from concrete encasement, provide a 4-inch length of Schedule 40 PVC conduit set in the concrete to protect the conductor.

3.02 Service Entrance Equipment

- A. Provide one ground cluster outside the building at the closest practical location to the service entrance equipment and bond to ground bus with a No. 4/0 conductor.
- B. If a metallic cold water pipe is available for a grounding electrode make connection on the street side and bond around the water meter.
- C. Prior to energizing the system remove the neutral link and meggar the system neutral. Repair any grounds then replace the neutral link.

3.03 Buildings

- A. Bond all steel building columns to the ground grid.

3.04 Separately Derived Systems

- A. Ground transformer enclosures and, where solidly grounded systems are indicated, the secondary neutral to one of the following:
 - 1. The building steel.
 - 2. Other electrode as permitted by NEC if none of the above are available.

3.05 Underground Distribution Systems

- A. Route a bare conductor through each duct bank. Connect to equipment frame or ground pad as applicable.
- B. Provide a driven ground rod at each electrical manhole. Connect to duct bank ground conductor accessible in the manhole.

3.06 Field Quality Control

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Compile and submit a list of ground resistance measurements for each ground rod in ground clusters. Measure and submit resistance to ground of service equipment ground bus.
- C. Make resistance to ground measurements in normal, dry weather conditions not less than 24 hours after rainfall. Make measurements using the fall of potential method per IEEE Standard No. 142.

END OF SECTION

Part 1 General

1.01 Scope

- A. Dry type two winding transformers.

1.02 Submittals

Submit product data. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, loss data, efficiency at 25, 50, 75 and 100 percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

1.03 Delivery, Storage and Handling

- A. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.
- B. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

Part 2 Products

2.01 Acceptable Manufacturers

Dry type transformers shall be equal to General Electric, Hevi-Duty, Siemens, Square D., or Cutler-Hammer.

2.02 Dry Type Transformers

- A. Dry Type Transformers: NEMA ST-20; factory-assembled, air cooled dry type transformers; ratings as indicated. Transformers are two winding power type. Three phase units are connected delta primary and wye secondary. Scott or Tee connections and autotransformers are not acceptable.
- B. Insulation: 220 degrees C, 150 degree C rise for ratings 30 kVA and larger; 185 degrees C, 115 degree C rise for ratings below 30 kVA.
- C. Taps: Two, 5 percent below rated primary for ratings 15 kVA and smaller; six, 2-1/2 percent two above and four below rated primary for ratings larger than 15 kVA.
- D. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- E. Mounting: Transformers 75 kVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 kVA shall be suitable for floor or trapeze mounting.

Dry Type Transformers

- F. Isolate core and coil from enclosure using vibration-absorbing mounts.

Part 3 Execution

3.01 Installation

- A. Set transformer plumb and level. Clear walls and ceilings by at least 6-inches to allow for air circulation.
- B. Use flexible conduit, two foot minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Provide seismic restraints.

3.02 Field Quality Control

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure secondary voltage under normal load conditions and make appropriate tap adjustments.

END OF SECTION

Part 1 General

1.01 Scope

- A. Panelboards.

1.02 Submittals

Submit shop drawings.

Part 2 Products

2.01 Acceptable Manufacturers

Equipment shall be manufactured by General Electric, Siemens, Square D, or Cutler-Hammer.

2.02 Panelboards

- A. Panelboards: NEMA PB-1; UL 67.
- B. Rating: Voltage and ampere ratings are shown on the Drawings. Unless otherwise indicated interrupting ratings (RMS symmetrical) are 14,000 amps for 480 volt panelboards and 10,000 amps for 240 and 208 volt panelboards.
- C. Boxes: Code gauge galvanized steel; sized to accommodate devices indicated and afford wire bending space in accordance with NEC requirements.
- D. Fronts: Surface or flush as indicated, door-in-door construction, finished in light grey enamel over a rust inhibitor. Furnish flush lock for fronts less than 48-inches high and vault type handle with three point catch for fronts 48-inches and higher. Key all locks alike.
- E. Bus: Copper, arranged for bolt-on circuit breakers. Furnish insulated neutral bus and ground bus with main lug bonded to the box. Exception: panels feeding SCADA equipment to have ground bus insulated from the box by use of stand-off insulators.
- F. Circuit Breakers: NEMA AB-1; molded case type, thermal-magnetic trip with internal common trip on multipole breakers. Provide breaker fully rated for interrupting ratings noted; series ratings are not acceptable.
- G. Provide engraved nameplates giving the voltage rating and panel designation as indicated. Provide a UL service entrance label for panelboards used as service entrance equipment.
- H. Two Section Panels: Box and front same height each section.
- I. Surge Protection: Where indicated provide transient voltage surge suppressor, UL

listed in accordance with UL 1449 (2nd Edition); suitable for medium exposure level ANSI/IEEE C62.41 Cat. C3 environments; total surge current shall not be less than 80 kA per phase or 40 kA per mode in accordance with NEMA LS-1. Provide surge suppressor with standard overcurrent protection (no fuses), integral disconnect and diagnostic indicating lights. Suppressor shall be installed either in the panelboard gutter unless space does not permit or panelboard UL label is voided – in which case furnish loose for field installation adjacent (less than five feet) to the panelboard. Suppressor shall be connected on the load side of the main disconnect device, as close as possible to the phase/neutral/ground conductors per manufacturer's recommendations.

Part 3 Execution

3.01 Installation

- A. Install boxes so they are rigidly supported and correctly aligned. Select mounting height so that operating handles are not higher than 6 feet 6-inches nor lower than 24-inches above the floor.
- B. For flush mounted panels provide a 3/4-inch empty raceway for each three unused spaces and spare poles. Terminate in a junction box located above the ceiling or other approved accessible location for future extension.
- C. Prior to energizing panelboards clean out construction dirt and debris. Paint any scratches on the trims or dead front barriers. Meggar each phase to phase and ground to insure that no short circuits exist.
- D. Adjust panel barriers so that no openings occur between them and the panel front. Provide filler plates and plugs as necessary to maintain dead front integrity.
- E. Type directory cards with circuit loads and/or area served. Note spare circuits in pencil.

3.02 Field Quality Control

Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

END OF SECTION

Part 1 General

1.01 Scope

- A. Individual motor starters.

1.02 Submittals

- A. Submit shop drawings.
- B. Provide product data on motor starters and combination motor starters, relays, pilot devices and switching and overcurrent protective devices.

1.03 Record Drawings

- A. Submit shop drawings as listed in Article 1.02 plus operation and maintenance data.
- B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.04 Delivery, Storage and Handling

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.05 Spare Parts

- A. Starter Contacts: One set for each NEMA size furnished.
- B. Starter Coils: One for each NEMA size furnished.
- C. Control Circuit Fuses: Three for each rating furnished. Provide one fuse puller.
- D. Pilot Light Lamps: Standard lot cartons equal to 10 percent of the number of lights furnished, one carton minimum.

Part 2 Products

2.01 Acceptable Manufacturers

Equipment shall be manufactured by Allen-Bradley, Cutler Hammer, General Electric,

Siemens, Square D, or Furnas.

2.02 Individual Motor Starters

- A. Manual Starters: NEMA ICS-2; general purpose type; trip free mechanism; with overload relays. Provide push button operation for integral horsepower sizes, and toggle switch for fractional sizes.
- B. Magnetic Starters: NEMA ICS-2; NEMA size 0 minimum; magnetically held contactor with field replaceable coil and contacts; bimetallic or melting alloy overload relay, manually reset. Starters shall be rated in accordance with NEMA size designations; fractional sizes and ratings per IEC recommendations are not acceptable.
- C. Magnetic Starter Controls: All controls are 120 volts. Equip each starter with a control power transformer fused on the primary and secondary. Provide starter and overload relay for red run light and amber overload light on the enclosure door. Provide one spare normally open starter auxiliary contact, and door mounted start-stop pushbuttons or hand-off-auto selector switch as indicated.
- D. Combination Starters: Molded case circuit breaker rated 22,000 AIC.

Part 3 Execution

3.01 Installation

- A. Select and install heater elements in motor starters to match installed motor characteristics. Do not use NEC motor full load ampere data for heater selection.
- B. Provide a typed label inside each motor starter enclosure door identifying the motor served and listing the motor nameplate data. Provide an engraved nameplate on the exterior of the enclosure door identifying the motor served, the horsepower, voltage and phase rating.
- C. Install individual starters and motor starter panelboards so they are rigidly supported and readily accessible. Where mounted on stud walls, provide a plywood backboard secured to the studs with the starter secured to the backboard. Provide stainless steel mounting channel or phenolic spacers to give nominal 1/2-inch separation from concrete walls in wet or damp locations.
- D. Touch up paint scratches and vacuum to remove construction debris and dirt. Install all doors, wireway covers etc., and plug any unused device holes.

END OF SECTION

Part 1 General

1.01 Scope

Low voltage motor control centers.

1.02 Quality Assurance

- A. Provide motor control centers manufactured and tested in accordance with NEMA ICS-2 and UL 845.
- B. Provide a UL label where applicable, on each unit and each vertical section. If a unit or section cannot be UL labeled so note on submittals along with reasons for same.
- C. NEMA Classification: Class IS, Type B.

1.03 Submittals

- A. Submit shop drawings in accordance with NEMA classification as noted above and additional information as noted in the following paragraphs.
- B. Elementary Diagrams: Provide a separate elementary diagram for each starter unit following the format shown on the Drawings and showing numbered terminal points and interconnections to the first level of remote devices.
- C. Reference Data: Submit one set of full size (11 x 14-inch) time current curves on log-log transparency paper for all overcurrent protective devices. Exception: A tabulation of heater sizes or elements versus motor current rating may be submitted in lieu of time current curves for overload relays.
- D. Indicate on shop drawings front and side views of motor control center enclosures with overall dimensions. Include conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings and time-current curves of all equipment and components.
- E. Provide product data on motor starters and combination motor starters, relays, pilot devices and switching and overcurrent protective devices.

1.04 Record Drawings

- A. Shop drawings; as listed in Article 1.03 corrected to reflect the equipment as-built.
- B. Operation and maintenance data including recommended maintenance procedures and intervals, spare parts listing, and instruction books for the equipment and components.

1.05 Delivery, Storage and Handling

- A. Arrange shipping splits as required for installation. Individually wrap each section and mount on shipping skids.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure and finish.

1.06 Spare Parts

- A. Starter Contacts: One set for each NEMA size furnished.
- B. Starter Coils: One for each NEMA size furnished.
- C. Control Circuit Fuses: Three for each rating furnished. Provide one fuse puller.
- D. Pilot Light Lamps: Standard lot cartons equal to 10 percent of the number of lights furnished, one carton minimum.
- E. Touch-Up Paint: One can.

Part 2 Products

2.01 Acceptable Manufacturers

Motor control centers shall be Allen-Bradley, Cutler-Hammer, General Electric, Square D or Furnas.

2.02 Ratings

- A. Service: 480 Volt, 3 Phase, 60 Hz.
- B. Short Circuit: Unless otherwise indicated device interrupting rating and bus bracing is 25,000 amperes rms symmetrical. Provide fully rated devices; series ratings are not acceptable.
- C. Ampacity: 300 amps minimum for vertical bus, as indicated for horizontal bus. Rating to be in accordance with UL standards for temperature rise.

2.03 Construction

- A. Equipment consists of the required number of vertical sections to accommodate all devices indicated and specified herein, each nominally 90-inches high and 20-inches

deep. Sections are bolted together to form a rigid free standing, front accessible, dead front assembly.

- B. Provide each section with isolated horizontal wireways at the top and bottom and isolated vertical wireways with hinged door and cable tie supports. Unused spaces are to have bussing for future units and blank door covers.
- C. Enclosures are NEMA 1A gasketed painted in the manufacturer's standard grey over a rust inhibitor treatment.
- D. Surge Protection: Provide transient voltage surge suppressor, UL listed in accordance with UL 1449 (2nd Edition); suitable for high exposure level ANSI/IEEE C62.41 Cat. C3 environments; total surge current shall not be less than 120 kA per phase or 60 kA per mode in accordance with NEMA LS-1. Provide surge suppressor with standard overcurrent protection, integral disconnect and diagnostic indicating lights. Suppressor shall be installed in an MCC bucket on the load side of the main disconnect device, as close as possible to the phase/neutral/ground conductors per manufacturer's recommendations.

2.04 Incoming Mains

- A. Provide incoming main lug as indicated.
- B. Arrange main lug for bottom cable entry without requiring 90 degree bends in the incoming conductors.

2.05 Starter Units

- A. Starters: Circuit breaker combination type rated in accordance with NEMA size designations. Fractional sizes and ratings per IEC recommendations are not acceptable.
- B. Breakers: Adjustable magnetic trip only. Equip with current limiters as required for the interrupting rating noted.
- C. Contactors: NEMA ICS-2; NEMA Size 1 minimum; magnetically held; field replaceable coil and contacts; auxiliary contacts field installable and removable. Terminal temperature rise is not to exceed 50 degrees C per NEMA standards.
- D. Overload Relays: Class 20 solid state, heaterless design, self-powered, front dial adjustable, \pm two percent repeat trip accuracy with pressure type terminals normally open, isolated auxiliary contact; manually reset by means of an external reset button.
- E. Units: Constructed to fully compartmentalize the starter and arranged to permit access to starter, control power transformer, fuses and other components without requiring disassembly. NEMA size 1 thru 4 are plug in, size 5 and larger are bolt on. Equip unit door with a defeatable interlock to prevent opening unless the disconnect is open. Use

Low Voltage Motor Control Centers

red color to clearly indicate on position; either uncovered when disconnect handle is moved to the on position or disconnect handle itself colored red on the side showing in on position.

- F. Terminal Blocks: Pull apart type for power and control to allow unit withdrawal without disconnecting wiring. Use screw type terminals suitable for ring and tongue lugs for control wiring and box lug type for power wiring.

2.06 Feeder Units

- A. Breakers: Molded case type, thermal-magnetic trips meeting UL 489 and NEMA AB-1. Ampere rating and interrupting ratings as noted.
- B. Units: Individually compartmentalized with not more than one breaker per unit unless otherwise indicated. Use red color to indicate on position as described above for starter units.

2.07 Bus

- A. Material: Copper, tin or silver plated at all joints.
- B. Isolation: Locate main bus at the top or center, completely compartmentalized with sliding or removable barriers for access to joints. Provide phase isolation for vertical bus by polyester barriers enclosing each phase bar or providing adequate creepage to restrict fault propagation. Plug all holes not used to stab in units.
- C. Provide ground bus rated 600 amps minimum extending the full length of the lineup. Where three phase, four wire control centers are indicated provide full length neutral bus rated a minimum of 50 percent of the main bus. Where three phase three wire control centers are used as service entrance equipment provide neutral bus in the incoming main section only.

2.08 Control Devices

- A. Elapsed Time Indicators: Six digit, non reset, 3.5-inch square case; equal to GE Type 236.
- B. Indicating Lights and Selectors: Heavy duty, oiltight, industrial grade with octagonal ring. Pilot lights are transformer type; LED for amber, red, and green and incandescent for other colors. Equal to Allen-Bradley, Bulletin 800T.
- C. Control Relays: Heavy duty, 600 volt, industrial grade, 10 amp contact rating. Equal to Allen-Bradley, Bulletin 700, Type P.

Part 3 Execution

3.01 Installation

- A. Install in accordance with the manufacturer's instructions.
- B. Install control centers on a 3-inch concrete pad and secure to sills imbedded in the concrete with 1/2-inch threaded bolts and nuts.
- C. Touch up paint scratches and vacuum to remove construction debris and dirt. Install all doors, wireway covers etc., and plug any unused device holes.

3.02 Tests

- A. Install overload relay thermal elements based on motor nameplate rating. If capacitors are installed between the relay and motor, select thermal elements based on the measured motor current. Adjust other overcurrent protective devices to settings per the coordination study.
- B. Meggar each bus, phase-to-phase and phase-to-ground.

END OF SECTION

Part 1 General

1.01 Scope

- A. AC variable frequency drives.

1.02 Related Work

- A. Section 11215 - Peristaltic Type Hose Pumps
- B. Section 11233 - Horizontal Split Case Centrifugal Pumps
- C. Section 16150 - Motors

1.03 Work Specified Elsewhere

Except as noted equipment specified in this Section is provided under other Divisions. Include, under this Division, receiving, storage and handling; wall or floor mounting of drive control panels (including equipment pads); and wiring.

1.04 Submittals

- A. Submit shop drawings.
- B. Submit installation instructions.

Part 2 Products

2.01 Acceptable Manufacturers

- A. AC Drives: Equal to Allen-Bradley, Powerflex 18-Pulse Series.

2.02 AC Drive Controllers

- A. Type: Variable frequency consisting of an input full wave rectifier and output inverter capable of producing a constant volts per hertz output suitable for operating a standard squirrel cage induction motor.
 - 1. 480 Volts and Below: Drives are pulse width modulated (PWM) 2-circuit board design with power components on one board and control components on another board.
 - 2. Drives to be complete with sensorless vector control.

B. Ratings

1. Speed Range: 6 to 60 Hertz with a constant torque load. Variable torque drives are permitted only where specifically noted.
2. Efficiency: 95 percent minimum at 100 percent speed.
3. Service Factor: 1.0 continuous; 1.5 for one minute.
4. Speed Regulation: 3 percent.

C. Equip drive with adjustments for minimum speed, maximum speed, acceleration-deceleration rate and current limit.**D. Protective Features**

1. Input molded case circuit breaker rated 22,000 AIC to disconnect the drive and control circuits.
2. Output contactor to disconnect the motor when the drive is off. Interlock contactor with drive to prevent starting unless the drive is at zero volts and hertz. Provide restart delay to allow equipment to coast to rest before restarting. Output contactor may be rated in accordance with NEMA or IEC standards. Where constant speed bypass is noted, provide bypass contactor rated in accordance with NEMA standards; IEC ratings are not acceptable.
3. Solid state protective circuits with diagnostic capabilities for over/under voltage, loss of voltage, inverse time and instantaneous overcurrent, phase loss, phase unbalance, and thermal overload. Activation of all protective functions shall be accomplished without damage to the drive and without need to replace any components. Over/under voltage and loss of voltage are to reset automatically when voltage returns to normal; all other conditions are to be manually reset.
4. Provide protective circuitry, if not inherent in the drive design, to shut down without damage to the drive if an out of synch condition occurs, i.e., running drive connected to a stopped motor, plug reversal or motor stall.
5. Where motor temperature switches are specified, provide circuitry to shut down the drive if the switch opens.

E. Input Voltage and Phase

1. 3 HP and Above: 480 volt, three phase.

F. Enclosures: Individual wall mounted, free standing or group assembly as noted. Enclosure shall meet NEMA 1 requirements. Oversize the drive and/or provide heat sinks on the drive and enclosure to allow operation in a 50 degree C ambient environment. Cooling fans are not acceptable. Provide thermostatically controlled space heater.

2.03 Controls

- A. Provide the following door mounted operator control devices:
1. Local-Off-Auto selector switch for remote start/stop and remote speed control.
 2. Manual start stop selector and speed adjustment knob.
 3. Speed indicating meter.
 4. Elapsed time meter for drives 5 HP and larger. Elapsed time meter may be included in drive diagnostic module or may be a separate six digit, non reset, 3-1/2-inch square case meter equal to GE type 236.
 5. "Run" and "Fault" indicating lights.
 6. Surge protection for 120 volt control circuit.
- B. Provide the following for remote control interface:
1. Remote start stop command, maintained dry contact, close to run.
 2. Two 120 volt powered contacts, one closed when motor operates and one open when motor operates, for accessories (motor space heater, pump seal water solenoid, etc.). Provide 750 VA spare capacity in drive control power transformer for accessories.
 3. Remote Ethernet communication module.
- C. For additional control requirements, refer to control schematic on Drawings.

2.04 Service Conditions

- A. Operating Temperature: 0 to 40 degrees C.
- B. Altitude: Up to 3,300 feet above sea level.
- C. Relative Humidity: 0 to 90 percent.
- D. Voltage Variation: +5 percent to -10 percent.

2.05 Drive Control Centers

- A. Description: Free standing group assembly with one or more drives in each section.
- B. Mains: Molded case circuit breaker or main lugs as indicated.
- C. Bus: Main horizontal bus as specified in Section 16481. Drives may be cable

Variable Speed Drives

connected to the main bus. Vertical bus, if used, shall comply with Section 16481.

- D. Where a section includes more than one drive provide metal barriers between individual units.
- E. Short Circuit Rating: 22,000 AIC.

Part 3 Execution

3.01 Installation

- A. Install in accordance with the manufacturer's instructions.
- B. Verify motor alignment prior to operation.
- C. Insure adequate space for air circulation around drive ventilation openings.

END OF SECTION

Part 1 General

1.01 Scope

- A. Interior luminaires and accessories.
- B. Exterior luminaires and accessories.
- C. Lamps.
- D. Ballasts.

1.02 Submittals

Submit product data. Include dimensions, accessories, installation and construction details, and photometric data.

1.03 Delivery, Storage, and Handling

- A. Ship laminated finish wood poles individually wrapped in moisture-resistant paper.
- B. Handle metal poles carefully to prevent breakage and damage to finish.

Part 2 Products

2.01 Acceptable Manufacturers

- A. Fixtures: Equal to fixtures shown on Fixture Schedule on the Drawings.
- B. Lamps: Equal to General Electric, Sylvania, Phillips Lighting.
- C. Ballasts: Equal to General Electric, Advance, Universal.
- D. Poles: Aluminum, equal to Union Metal, US Pole, Hapco.

2.02 Interior Luminaires and Accessories

- A. Provide fixtures as shown in the Lighting Fixture Schedule on the Drawings.
- B. Where flat acrylic lenses are specified in fluorescent fixtures, use 100 percent virgin acrylic, pattern 12; 0.125-inch thickness.
- C. Provide fixture housings and frames to match the ceilings called for on the Architectural Drawings.
- D. HID Luminaires: Pre-wired, with integral ballast.

2.03 Exterior Luminaires and Accessories

Provide low temperature ballasts, with reliable starting to -20 degrees F.

2.04 Lamps

- A. Fluorescent Lamps: Cool white; all by same manufacturer.
- B. Fluorescent PL Lamps: 2700 degrees K, all by same manufacturer.
- C. Metal Halide HID Lamps: Phosphor coated.
- D. High Pressure Sodium HID Lamps: Clear, suitable for all burning positions.

2.05 Ballasts

- A. Use ballasts designed to operate on the voltage to which they are connected.
- B. Fluorescent Ballasts: UL 935, ANSI C82.1; labeled Certified Ballast Manufacturers (CBM) certified by Electrical Testing Laboratories (ETL); high power factor type (unless indicated otherwise). Use Class P ballast with sound rating "A" (unless otherwise noted). Use fixtures and ballasts designed and constructed to limit the ballast case temperature to 90 degrees C when installed in an ambient temperature of 40 degrees C.
- C. HID Ballasts: UL 1029 and ANSI C82.4; constant wattage autotransformer (CWA) or regulator, high power factor type, (unless otherwise indicated). Use single-lamp ballasts with a minimum starting temperature of minus 30 degrees C and designed for installation in a normal ambient temperature of 40 degrees C. Use ballasts constructed so that open circuit operation will not reduce the average life. Provide High Pressure Sodium (HPS) ballasts with a solid-state igniter/starter with an average life in the pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 degrees C. Average life is defined as the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

2.06 Lighting Poles

- A. Hand Hole: 2.5 x 5-inch with removable weatherproof cover installed 18-inches above bottom of pole. Provide matching gasketed cover plate.
- B. Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washers, and hex nuts for each pole.

2.07 Lighting Control

- A. Provide a photo/time control center of the seven day calendar dial type suitable to operate mechanically held relays. Provide time switch with a function to prevent

energization of lighting for preset periods each day and permit different On-Off settings for each day of the week with provision for omitting selected days. When permitted by the time switch, the photocontrol operates the control center to energize whenever natural lighting falls below 25 footcandles.

- B. Provide manual switching for each circuit to maintain lighting "ON" or "OFF" until manually returned to the "Automatic" position. Provide a case cover to provide external accessibility of the bypass switches.
- C. Provide a spring driven timing motor to operate time switch controls at least 16 hours after power failure. Equip to transfer to synchronous motor drive and automatically rewind reserve on restoration of power.
- D. Provide a photo-cell with the control center.

Part 3 Execution

3.01 Installation

- A. Install lamps in luminaires and lampholders.
- B. Install fixtures to center or replace acoustical tile sections. Support fixtures from the building structure through the use of the ceiling support system, where the ceiling support system is designed for the lighting fixture's weight. Fluorescent lighting fixtures installed in exposed ceiling grid ceilings: provide two "safety clips" or "safety hooks" for securing fixture to ceiling grid, and located at opposite corners of fixture.
- C. Where fluorescent fixtures are installed in exposed grid ceilings provide a 14 gauge galvanized safety hanger wire which attaches the fixture to the building structural system to prevent the fixture from falling due to movements in ceiling suspension channels. Attach the safety wire to fixture at a point other than where safety clips are attached.
- D. Provide suspended fixtures with swivel hangers and threaded rod. For single-unit suspended fluorescent fixtures, provide twin suspension hangers.
- E. Support surface lighting fixtures of more than 10 pounds in weight with threaded rods from the building structure.
- F. Install plaster frames for lighting fixtures recessed in plastered ceilings.
- G. HID Luminaires: Use power hook hangers rated 500 pounds minimum or provide safety chain between ballast and structure. Provide safety chain between reflector and ballast.
- H. Luminaire Pole Bases: Size and constructed as indicated on Drawings. Project anchor bolts 2-inches minimum above base. Install poles on bases plumb; provide double nuts for adjustment. Grout around pole base.

Lighting Fixtures

- I. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.

3.02 Relamping

Relamp luminaires at completion of work.

3.03 Adjusting and Cleaning

- A. Clean lenses and diffusers at completion of work. Clean paint splatters, dirt and debris from installed luminaires.
- B. Touch up luminaire and pole finish at completion of work.
- C. Mount continuous rows of luminaires in straight line. Utilize alignment clips between reflectors, where applicable.

END OF SECTION

Part 1 General

1.01 Scope

- A. Emergency lighting units.
- B. Emergency exit signs.

1.02 Regulatory Requirements

Conform to local building code NFPA 101 for installation requirements.

1.03 Submittals

- A. Submit product data.
- B. Provide product data on emergency lighting units, and exit signs.

Part 2 Products

2.01 Acceptable Manufacturers

- A. Provide fixtures as listed in the Lighting Fixture Schedule on the Drawings.
- B. Substitutions: Products equal to those listed.

2.02 Lighting Equipment

- A. Emergency Lighting Units: Self-contained unit with 12 volt lead calcium rechargeable batteries with 1.5 hour capacity, and dual-rate charger with self-test feature as specified herein, and 120/277 volt.
- B. Self-Contained Exit Signs: Incandescent or fluorescent as indicated; with sealed lead acid or lead calcium maintenance free for 10 years under normal conditions, and dual rate charger with self-test feature as specified herein 120/277 volt.
- C. Self Test Unit: Provide switch to transfer from normal to battery; indicators for "AC ON" and "Recharging"; circuitry to include, 15 minute time delay, low voltage battery disconnect, and brown out protection. Include self test/discharge which will perform a 5 minute test/discharge every 30 ± 4 days and a 30 minute test/discharge every $6 \pm .5$ months, and indicate transfer circuit, charger, or battery malfunction.
- D. Battery: Sealed lead acid or lead calcium cell, requiring no maintenance or replacement for 10 years under normal conditions.

Part 3 Execution

3.01 Installation

- A. Replace all burned out lamps prior to final inspection.
- B. Install lighting fixtures plumb, square, and level with ceiling and walls. Secure in accordance with manufacturer's directions and approved shop drawings.
- C. Securely fasten emergency lighting units to shelf mounting brackets.

END OF SECTION

Part 1 General

1.01 Scope

Fire alarm system.

1.02 System Description

- A. Supervised, non-coded, annunciated, 24 volt DC system.
- B. Provide fully supervised fire alarm stations, thermal detectors, products-of-combustion detectors, annunciated circuits, sprinkler circuits, horn strobe units.
- C. Design system to operate with manual stations, detectors, sprinkler circuits as follows:
 - 1. Actuate control panel to cause evacuation alarm continuously throughout building.
 - 2. Indicate alarm origin on annunciator.
 - 3. Transmit signal to SCADA.

1.03 Regulatory Requirements

- A. Installation subject to approval, inspection, and test of applicable regulatory agency.
- B. Provide equipment listed by UL, tested by a nationally recognized fire test laboratory, and compatible with integrated fire alarm system.

1.04 Submittals

- A. Submit shop drawings and product data.
- B. Indicate system components, size of components, location, and provide full schematic or wiring system showing building and operation details.
- C. Submit manufacturer's installation instructions.

1.05 Record Drawings

- A. As listed in Article 1.04 plus maintenance and repair data.
- B. The manufacturer shall submit, on completion of system verification, a point-by-point check list indicating the date and time of each item inspected and issue a certificate confirming that the inspection has been completed and the system is installed and functioning in accordance with the Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

System shall be manufactured by Notifier, Siemens or Edwards.

2.02 Fire Alarm Boxes

- A. Manual: Non-coded, flush mounted unless otherwise indicated, indicating operation physically until reset.
- B. Contacts: Equipped with one set normally open contacts.

2.03 Heat Detection Equipment

- A. Detectors: Combined fixed temperature rate of rise 135 degrees F (57 degrees C) for ceiling mounting.
- B. Rate of Rise: 14 degrees F (8 degrees C) per minute.
- C. Resetting: Provide fixed temperature detectors of automatic reset type.

2.04 Products of Combustion Detectors

- A. Capable of detecting products of combustion without requirements for presence of heat or smoke; unaffected by changes in environmental temperature, humidity, and pressure; to have field adjustable sensitivity measuring facility; surface mounted; indicator lamp; smoke verification feature; designed for operation on 24 volts; design and function based on dual chamber principle.
- B. Furnish duct mounting units complete with duct casting and sampling tubes.

2.05 Alarm Devices

- A. Horn Strobe Units: Parallel operation; surface mounted; with audio output of not less than 96 dBA at 10-feet on axis.

2.06 Annunciators

- A. Provide annunciator at control panel for system only.
- B. Indicate trouble on annunciator panel when fault occurs on system. Incorporate buzzer, pilot light, and silencing switch.
- C. Lamp Type: Unsupervised, flush mounted, 24 volt.

- D. Provide panel complete with stainless steel or aluminum trim and door with captive holding studs.
- E. Etch annunciator windows with black letters on white background.

2.07 Control Panel

- A. Steel construction, painted with red enamel finish, hinged front cover, key locked.
- B. Design control panel for connection to SCADA. Provide one set of normally open contacts.
- C. Equip panel with:
 - 1. Door mounted annunciator panel.
 - 2. Separate trouble light for each supervised circuit.
 - 3. Trouble buzzer light and trouble silence switch.
 - 4. Separate pilot lamp to supervise standby power.
 - 5. System reset switch.
 - 6. Silence switch.
- D. Provide supervision of system as follows: A break or a ground on a fire alarm station or detector circuit or operation of evacuation alarm horn silence switch causes trouble signal and trouble lamp illuminated. Trouble signal silence switch silences buzzer but lamp remains illuminated. On restoration of the system, the trouble signal remains energized until trouble signal silence switch is restored to normal. On loss of normal AC power, the trouble alarm operates and illuminates emergency power supervisory pilot lamp. Operation of the trouble alarm silence switch silences trouble signal but power supervisory lamp remains illuminated. On restoration of normal power, trouble alarm remains energized until the silence switch is restored to normal.
- E. Incorporate relays in control panel to control and activate systems as outlined under related systems.

2.08 Power Supply

- A. Take power supply from independent 120 volt, 15 ampere circuit.
- B. Provide rectifier as part of control panel or as separate unit to automatically maintain standby battery bank fully charged under normal conditions and sized to recharge standby batteries in 12 hours maximum, following emergency operation. Rectifier to operate the system when batteries are disconnected.

Fire Alarm System

- C. Provide standby battery bank floating across the line. Provide sealed lead acid or nickel cadmium batteries of sufficient capacity to operate system under supervision load conditions without recharging for 24 consecutive hours and then have sufficient power left to operate sounding devices for ten minutes. Mount batteries in fire alarm control panel.

Part 3 Execution

3.01 Installation

- A. Provide and install fire alarm wiring in conduit. Minimum wire size is No. 14 AWG copper.
- B. Fire alarm conductor terminations in control panel to be made on terminal strips with separate point for each conductor. All such strips to be number identified as shown in wiring diagram attached to inside of door of control panel. Connect wiring neatly to terminal strips. Connect clip with nylon cable straps. Set up termination of cabling so that sections of the system may be isolated or shorted out for servicing.
- C. Mount end-of-line resistor for each box circuit in separate box located not more than six feet above finished floor beyond the last manual alarm station or automatic initiating device in a circuit.
- D. From fire alarm control panel, make connection to motor control centers and related equipment as required for fan system control.
- E. From fire alarm control panel provide one 3/4-inch conduit to nearest telephone backboard or panel location for tie-in to central station.
- F. Provide signal connection to elevator controller.
- G. Mount fire alarm boxes at 60-inches above finished floor.
- H. Install power supply circuit disconnect in a location that is accessible only to authorized personnel.

3.02 Field Quality Control

- A. Have fire alarm equipment supplier make a thorough inspection of the complete installed fire alarm systems including all components to ensure the following:
 - 1. Complete and functional system.
 - 2. Underwriter's Laboratories requirements.
 - 3. Installed in accordance with manufacturer's instructions.
 - 4. Regulations covering supervision of components are adhered to.

5. Make changes necessary to conform to Items 1, 2, 3 and 4 with technical assistance from the manufacturer.
6. During the period of this inspection by the manufacturer, supply to the manufacturer one electrician and one apprentice.

END OF SECTION

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Part 1 General

1.01 Scope

Telephone raceway system.

1.02 System Description

- A. Conduit including fire stopping and outlets.
- B. Cabling and jack assembly.

Part 2 Products

2.01 Equipment

- A. Conduits: As specified in section 16111.
- B. Conduit Bends: Long radius, minimum inside radius 10 times the conduit diameter.
- C. Cover Plates: One hole, 5/8-inch minimum diameter.
- D. Telephone Backboards: 4 x 4 foot x 3/4-inch grade BC plywood.
- E. Voice Cable: Comply with EIA/TIA-568-A. Four (4) thermoplastic insulated, individually twisted pairs of conductors; No. 24 AWG, color coded, enclosed in PVC jacket.
- F. Boxes: As specified in Section 16130
- G. Jacks and Jack Assemblies: Modular, color-coded RJ-11 receptacle unit with integral IDC type terminals. Color-coded white/blue, white/orange, white/green, white/brown.

Part 3 Execution

3.01 Cooperation

- A. Verify and comply with all telephone company requirements. Coordinate locations of pull boxes, sleeves, backboards and termination points. Install inserts and pulling eyes at locations required for pulling telephone cables.
- B. Provide access to the facility and reasonable amenities to the telephone installer; including the use of light, power, rest room facilities, construction elevators and trash removal.

3.02 Installation

- A. Provide pullboxes in telephone conduit runs spaced not greater than 100 feet apart, and on backboard side of runs with more than two right angle bends.
- B. Place TELEPHONE label on pull and junction boxes.
- C. For conduits 2-inches and larger terminating in a pull box, the minimum box length is 16 times the diameter of the largest conduit terminating in the box.
- D. Provide 3/4-inch conduit with #6 insulated ground wire from backboards to nearest available building grounding point.
- E. Place 130 pound minimum tensile strength pull line in all empty telephone conduits.
- F. Provide double duplex receptacle and ground bus at all telephone backboards. Connect ground bus to nearest available building ground with #6 ground wire.

END OF SECTION

Part 1 General

1.01 Scope

Mechanical equipment controls.

1.02 Related Work

- A. Section 16111 - Conduit.
- B. Section 16120 - Wires and Cables.
- C. Section 16481 - Motor Control Centers.
- D. All automatic control devices control components to be provided by Division 15.
- E. Connection from motor control center to control devices by Division 16.

Part 2 Products - Not Used

Part 3 Execution

3.01 Installation

- A. Cooperate with Division 15 in connection of control conduit with devices.

END OF SECTION



Part 1 General

1.01 Scope

- A. Provide all equipment, tools, rigging, and experienced technicians to insure the completion of services as outlined herein.
- B. A complete written report shall be furnished including a listing of equipment which needs repair, equipment settings, "As Found" and "As Left" condition, forms for breaker test, transformer test, etc., as required for pertinent data and acknowledgment that the work has been completed.
- C. Applicable Codes, Standards and References
 - 1. All inspections and tests shall be in accordance with the following codes and standards, except as provided otherwise herein.
 - a. National Electrical Manufacturer's Association (NEMA)
 - b. American Society for Testing and Materials (ASTM)
 - c. Institute of Electrical and Electronic Engineers (IEEE)
 - d. International Electrical Testing Association (NETA) Maintenance Testing Specifications - MTS-1989
 - e. American National Standards Institute (ANSI) - ANSI C2: National Electrical Safety Code
 - f. State and local codes and ordinances
 - g. Insulated Cable Engineers Association (ICEA)
 - h. Association of Edison Illuminating Companies (AEIC)
 - i. Occupational Safety and Health Administration (OSHA)
 - j. National Fire Protection Association (NFPA)
 - i. ANSI/NFPA 70: National Electrical Code
 - ii. ANSI/NFPA 70B: Electrical Equipment Maintenance
 - iii. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
 - iv. ANSI/NFPA 78: Lightning Protection Code
 - v. ANSI/NFPA 101: Life Safety Code

Testing**D. Definitions**

1. Low Voltage: 0 to 600 volts.
2. Medium Voltage: 1 KV to 15 KV.

Part 2 Equipment Testing**2.01 Molded Case Circuit Breaker - 100 AMP and Above****A. Mechanical and Visual Inspection**

1. Refer to the manufacturer's instruction manual.
 - a. Check breaker against single-line drawing or panel schedule for correct rating, conductor size, and feeder designation.
 - b. Clean breaker case and inspect for cracks, heat damage, or other defects.
 - c. Check external connections for tightness, and signs of overheating. Torque bolts to the manufacturer's specifications.
 - d. Remove breaker covers on unsealed units. Inspect internal components for conditions and check for tightness on removable trip units, fused breakers, etc. (Do not remove any cover or components of breakers which will void UL label.)
 - e. Operate breaker three times to insure smooth operation.

2.02 Switches**A. Low Voltage Air Switches**

1. Mechanical and Visual Inspection
 - a. Inspect for physical and mechanical condition.
 - b. Check for proper anchorage and required area clearances.
 - c. Perform mechanical operation tests.
 - d. Check blade alignment.
 - e. Check each fuse holder for adequate mechanical support of each fuse.
 - f. Inspect all bus or cable connections for tightness torque in accordance with the manufacturer's recommendations.

Part 1 General

1.01 Scope

- A. Furnish all labor, materials, equipment and incidentals required to complete and make ready for operation all valves and appurtenances as shown on the Drawings and as specified herein.
- B. The equipment shall include, but is not limited to, the following:
 - 1. Butterfly Valves
 - 2. Check Valves
 - 3. Air Release Valves
 - 4. Pinch Valves
 - 5. Needle Valves
 - 6. Pressure Sensors
 - 7. Pressure Gauges
 - 8. Fire Hydrants
 - 9. Valve Boxes
 - 10. Floor Boxes
 - 11. Pedestal Operators for Valves
 - 12. Stem Guides
 - 13. Extension Stems
 - 14. Motorized Operators

1.02 Submittals

- A. Submit to the Engineer within 30 days after execution of the Contract a list of materials to be furnished, the names of the suppliers and the date of delivery of materials to the site.
- B. Complete shop drawings of all valves and appurtenances shall be submitted to the Engineer for approval in accordance with Section 01340 of these Specifications. Clearly indicate make, model, location, type, size and pressure rating.

1.03 Storage and Protection

Valves and all associated accessories shall be stored and protected in accordance with the requirements of Section 01640 of these Specifications.

1.04 Quality Assurance

The manufacturer shall provide written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

- A. Provide valves of same manufacturer throughout where possible.
- B. Provide valves with manufacturer's name and pressure rating clearly marked on the outside of the valve body.
- C. Acceptable manufacturers are as follows:
 - 1. Butterfly valves (Liquid Service) shall be manufactured by Mueller, Pratt, Val-Matic, or Miliken.
 - 2. Butterfly valves (Air Service) shall be manufactured by Mueller, Pratt or Clow.
 - 3. Check valves shall be manufactured by G-A Industries or APCO Valve Corporation.
 - 4. Air release valves shall be manufactured by APCO Valve Corporation, Val-Matic or Crispin.
 - 5. Air and vacuum valves shall be manufactured by APCO Valve Corporation, Val-Matic or Crispin.
 - 6. Single body, double orifice valve shall be manufactured by APCO Valve Corporation.
 - 7. Pinch valves shall be manufactured by Red Valve Company.
 - 8. Needle valves shall be manufactured by Chemtrol (CN Series).
 - 9. Iron Body Diaphragm Valves shall be ITT Grinnell Dia-Flo 2800 or Red Valve - Thermoplastic Valve shall be manufactured by Hayward, Chemtrol or Spears.
 - 10. PVC Ball Valves (PBLV) shall be Hayward "Safe Block", ASAHII/AMERICA DUO-BLOC, or Chemtrol TV Series, or Spears True Union 2000.

11. PVC Ball Check Valves shall be Hayward "True Check" or ASAHI/AMERICA Ball Check, or Chemtrol BC Series or Spears (True Union 2000 Industries).
12. Discharge pressure sensor shall be Ronningen-Petter Iso-Spool and Iso-Ring Pressure, or Red Valve pressure sensors.
13. Pressure gauges shall be equal to Helicoid Type 410.
14. Valve boxes shall be Clow F-2450.
15. Floor boxes shall be Clow F-5695 and shall be furnished by the manufacturer of the associated valve.
16. Stem guides shall be Clow F-5660 and shall be furnished by the valve or gate manufacturer.
17. Type I Motorized Operators shall be Model SA/SAR with automatic controller as manufactured by Auma Actuators.
18. Type II Motorized Operators shall be Nibco Series 500 without exception.
19. Fire Hydrants shall be manufactured by Mueller, Waterous, U.S. Pipe, M & H, Kennedy, or American Darling, without exception.

2.02 Materials and Construction

A. Valve Connections

1. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.
2. Thread pipe sizes 2-inches and smaller.
3. Flange pipe sizes 2-1/2-inches and larger.
4. Solder or screw to solder adapters for copper tubing.

B. Butterfly Valves for Liquid Service (BV)

1. Butterfly valves shall be resilient seated, short body design, and shall be designed, manufactured, and tested in accordance with all requirements of AWWA C504 for Class 150B.
2. Valve bodies shall be ductile iron conforming to ASTM A 536, Grade 65-45-12 or ASTM A 126, Grade B cast iron. Shafts shall be ASTM A 276, Type 304 stainless steel, machined and polished. Valve discs shall be ductile iron, ASTM

A 536, Grade 65-45-12 or ASTM A 126, Grade B cast iron. The resilient valve seat shall be located either on the valve disc or in the valve body and shall be fully field adjustable and field replaceable.

3. Valves shall be installed with the valve shafts horizontal. Valves and actuators shall have seals on all shafts and gaskets on valve actuator covers to prevent the entry of water. Actuator mounting brackets shall be totally enclosed and shall have gasket seals.
4. Actuators
 - a. Valves shall be equipped with traveling nut, self-locking type actuators designed, manufactured and tested in accordance with AWWA C504. Actuators shall be capable of holding the disc in any position between full open and full closed without any movement or fluttering of the disc.
 - b. Actuators shall be furnished with fully adjustable mechanical stop-limiting devices. Actuators that utilize the sides of the actuator housing to limit disc travel are unacceptable.
 - c. Valve actuators shall be capable of withstanding a minimum of 450 foot pounds of input torque in either the open or closed position without damage.
5. Operators: Valves for buried service shall have a nut type operator and shall be equipped with a valve box and stem extension, as required.
6. Valve ends shall be mechanical joint type, except where flanged or restrained joint ends are shown. Flange joints shall meet the requirements of ANSI B16.1, Class 125.
7. Provide motor operators as specified elsewhere, where indicated on the Drawings.

C. Butterfly Valves for Air Service (BVA)

1. Butterfly valves shall be resilient seated, short body design, and shall be designed, manufactured, and tested in accordance with all requirements of AWWA C504. Valves shall be designed for a rated working pressure of 25 psi and a minimum service temperature of 250 degrees F.
2. Valve bodies shall be ductile iron conforming to ASTM A 536, Grade 65-45-12 or ASTM A 126, grade B cast iron. Shafts shall be 304 stainless steel, machined and polished. Valve discs shall be ductile iron, ASTM A 536 Grade 65-45-12. The resilient valve seat shall be located either on the valve disc or in the valve body and shall be fully field adjustable and field replaceable.

S P E C I F I C A T I O N S

FOR

NORTHERN KENTUCKY WATER DISTRICT

Memorial Parkway Treatment Plant Improvements

JULY 2006

RON LOVAN, PRESIDENT/CEO

COMMISSIONERS:

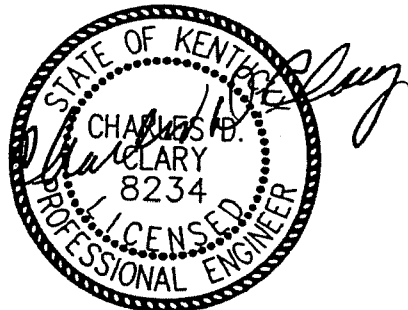
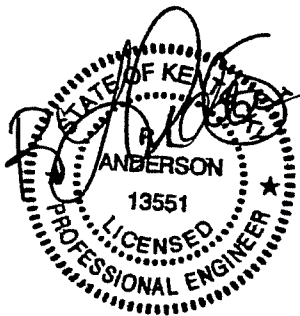
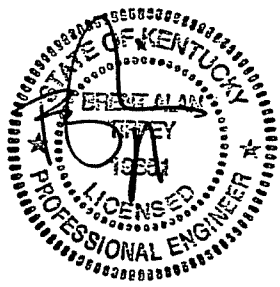
**JOE KOESTER - CHAIRPERSON
ANDREW COLLINS - SECRETARY
FRED MACKE, JR. - TREASURER
PAT SOMMERKAMP - COMMISSIONER
FRANK JACKSON - COMMISSIONER
DOUG WAGNER - COMMISSIONER**

CHARLES PANGBURN - ATTORNEY

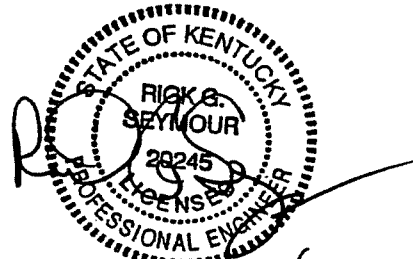
MEMORIAL PARKWAY TREATMENT PLANT IMPROVEMENTS

NORTHERN KENTUCKY WATER DISTRICT

FORT THOMAS, KENTUCKY



4-4-06



4/27/06

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ADDENDUM NO. 1

MEMORIAL PARKWAY TREATMENT PLANT IMPROVEMENTS NORTHERN KENTUCKY WATER DISTRICT July 27, 2006

All Bidders on the above titled Project are hereby advised of the following modifications to the Specifications and Drawings on the Project. These modifications will be a part of the resulting Contract.

SPECIFICATIONS

Item No. AD1-1: Invitation to Bid (Section 00020)

The Bid Date has been changed to August 8, 2006 at 2:00 PM, local time. The bids will be received at the Northern Kentucky Water District Central Facility, 2835 Crescent Springs Road, Erlanger, KY, 41018.

Item No. AD1-2: Instructions to Bidders (Section 00100)

Add Item 23 and 24 as follows:

23. Certain project components may be eligible for exemption from state sales tax. The applicable Kentucky Administrative Regulation (KAR) and Kentucky Revised Statute (KRS) are attached to this Addendum. The Bidder is solely responsible for the determination of any exempt items.
24. The City of Fort Thomas and Campbell County both have payroll and net profits taxes. The Fort Thomas payroll and net profits tax rates are 1.25%. The Campbell County payroll and net profits tax rates are 1.05%.

Item No. AD1-3: Bid Form (Section 00300)

A copy of the Bid Form has been attached to this Addendum for the Bidder's convenience. Please use this form to submit the Bid.

Item No. AD1-4: Supplements to the Bid Form (Section 00400)

A copy of this Section has been attached to this Addendum for the Bidder's convenience. This section must be submitted with the Bid Form.

Item No. AD1-5: Bid Bond (Section 00410)

A copy of this Section has been attached to this Addendum for the Bidder's convenience. This section must be submitted with the Bid Form.

Item No. AD1-6: Statement of Bidder's Qualifications (Section 00420)

A copy of this Section has been attached to this Addendum for the Bidder's convenience. This section must be submitted with the Bid Form.

Item No. AD1-7: Corporate Certificate (Section 00422)

This Section has been deleted.

Item No. AD1-8: Proposed Subcontractors (Section 00423)

Instrumentation and Control has been added to the Subcontractor table. A new Section is attached to this Addendum. This section must be submitted with the Bid Form.

Item No. AD1-9: Contractor's License Certification (Section 00424)

This Section has been deleted.

Item No. AD1-10: Non-Collusion Affidavit (Section 00460)

A copy of this Section has been attached to this Addendum for the Bidder's convenience. This section must be submitted with the Bid Form.

Item No. AD1-11: Agreement (Section 00500)

As a clarification, 10% retainage will be held for the entire duration of the project as identified in this Section.

Item No. AD1-12: Employment Requirements and Wage Rates (Section 00850)

This Project is subject to State Wage Rates. Applicable rates are attached to this Addendum.

Item No. AD1-13: Unique Requirements (Section 01011)

Article 1.06 has been deleted.

Item No. AD1-14: Self-Priming Chemical End Suction Centrifugal Pumps (Section 11230)

Article 2.04, delete the first paragraph and replace with the following:

The pump manufacturer shall furnish a power monitoring system equal to SundGard Power Monitor PM-1000 with display unit PM-2000. The PM-1000 monitor shall operate at 120 VAC with a 10 VDC output to the PM-2000 display unit. The PM-2000 shall include the following:

- a. 3-digit LED Display
- b. Low trip, high trip and start-up delays
- c. Trip range adjustment = 5-100%
- d. Remote reset
- e. 4:20 mA output
- f. NEMA 4X Rating

Item No. AD1-15: Chemical Metering Pumps (Section 11249)

Revise Article 2.01 as follows:

- A. All chemical metering pumps shall be manufactured by Milton Roy (Centrac S pump with B motor and controller).

Revise Article 2.02 (C) as follows:

- C. The pump shall be capable of delivering 1.02 to 100 percent...

Revise Article 2.04 as follows:

1. Centrac S pump motor shall be a 56C frame separately mounted Centrac B motor.

Delete Article 2.04 (2.).

Item No. AD1-16: Water Filter and Appurtenances (Section 11374A)

Article 2.01 is revised to also include Roberts Filter Trilateral Underdrain and General Filter Multiblock Underdrain as Acceptable Manufacturers.

Item No. AD1-17: Fiberglass Storage Tanks (Section 13215)

Revise Article 2.08 (2.) by replacing "right angle helical" with "in line planetary" in the third sentence. Also replace 7/8" with 3/4" in the last sentence.

Item No. AD1-18: PVC, CPVC, Dual Containment Pipe, Flexible Hose and Strainers (Section 15069)

Revise Article 2.02 (F) as follows:

- F. All field welding shall be either butt welded per the general guidelines of ASTM D-2657 for polyolefin piping, and in accordance with the manufacturer's printed guidelines, or joints shall be solvent-cement joints using PVC cement ASTM D-2564. Splitting and re-welding shall not be permitted.

Delete Article 2.03 (H.)

Item No. AD1-19: Valves (Section 15100)

Revise Article 2.01 (C.) (1.) and (2) to also include DeZurik as an Acceptable Manufacturer.

Item No. AD1-20: Pad Mounted Transformers (Section 16325)

Add the following Article:

3.03 Demolition

Contractor shall be completely responsible for removal and disposal of the existing 225 kVA outdoor transformer at the RWTS. Based on records from NKWD, the transformer contains PCBs and therefore, must be disposed of as per EPA Regulations, Title 40, Part 761. Once the transformer has been removed, it must be properly disposed within one year. Contractor must provide written verification of disposal.

Item No. AD1-21: Instrument I/O Listing (Section 17180)

Article 1.01 A.1.b., "LCP-CHEM I/O List", pages 11 and 12 - I/O Reference Nos. 425 - 472 shown as digital inputs, Type "DI" should be digital outputs, Type "DO".

DRAWINGS

Item No. AD1-22: Site Plan & Yard Piping (Sheet C-1)

A detail for the concrete driveway areas has been added and is attached to this Addendum. The concrete thickness has been revised to 8".

Notes 9 and 17 should be revised as follows:

9. Connect 2" PVC SDR 21 Potable Waterline to existing line near front gate as shown on Sheet C-2. Approximate length of pipe between new driveway and the tie-in point shown on C-2 is 185 feet.
17. Connect 6" D.I. Fire Suppression line to existing line near front gate as shown on Sheet C-2. Approximate length of pipe between new driveway and the tie-in point shown on C-2 is 185 feet.

Item No. AD1-23: Chemical Building Sitework Details (Sheet C-2)

The indicator arrow for Note 4 on the Plant Water Connection Plan refers to the wrong location. It should be revised to show the connection point for the potable water system.

Note 6 on the Plant Water Connection Plant should be revised to identify PVC SDR 21 as the appropriate pipe material.

Item No. AD1-24: Chemical Feed Building Overall Plan (Sheet M-3)

The top of slab elevations for the recessed slabs in the Corrosion Control area and the Filter Aid Polymer area are revised to be 759.50'.

Item No. AD1-25: Chemical Building Partial Plan (Sheet M-6)

As a clarification, the Contractor is not responsible for providing any Corrosion Inhibitor or Filter Aid Polymer chemical. Equipment systems shall be provided by the Contractor as shown and specified.

Item No. AD1-26: Chemical Building Copper Sulfate/Sodium Hypochlorite Areas Section (Sheet M-11)

As a clarification, the Contractor is not responsible for providing any Copper Sulfate chemical. Equipment systems shall be provided by the Contractor as shown and specified.

Item No. AD1-27: Filter Underdrain Option No. 1 Plans and Sections (Sheet M-31)

Revise the height shown on Standard Block Underdrain Profile to 13" when the media support cap/plate is included.

Item No. AD1-28: Chemical Building Infill and New Foundation Plan (Sheet S-1)

The Ferric Sulfate/PACL area should be revised in order to show another sump pump area (total of two) as detailed on Drawing M-3.

Item No. AD1-29: Chemical Building New Roof Framing Plan (Sheet S-2)

The New Roof Framing Plan should be revised to show 29 precast concrete panels (4'-0" each).

On Section D, the PAC concrete slab should be revised to 5" in thickness.

Item No. AD1-30: Chemical Building Sections and Details (Sheet S-3)

On Section B, the concrete slab outside the building should be revised to 8" in thickness as shown on other sections.

The note on Section C should be revised to indicate an 8" thick CMU wall.

On Section E, the concrete floor slab should be revised to 6" thick as shown elsewhere in the Drawings.

On Section H, the wall height should be revised to 8' as shown elsewhere on the Drawings.

Item No. AD1-31: Chemical Building Notes and Details (Sheet S-5)

On Section B, the waterstop shown should be a "dumbbell" type and meet the following specification:

Waterstop: PVC, minimum 1,750 PSI tensile strength, -51 degrees F to +175 degrees F working temperature range; flat profile; corrugated flaps, large split center bulb; size as noted on the Drawings (or 6 inches if not shown).

Item No. AD1-32: Existing Sludge Handling Facilities – Modifications for RWTS Pump VFDs (Sheet E-10)

Add a 600 amp, 480 volt, fusible disconnect switch in NEMA 4X enclosure for the feeder from the pad mount transformer to the transfer switch. Fuse at 450 amp. Switch to be exterior wall mounted at the point where the feeder enters the building.

Item No. AD1-33: Plant Overall One-Line Diagram Revised (Sheet E-14)

Delete the 1,000-amp breaker shown on the primary side of the new 300 kVA transformer. Specification Section 16325 requires a 200-amp switch on the transformer primary.

Item No. AD1-34: Plant Overall One-Line Diagram Revised (Sheet E-14)

Add the following notes:

General Notes:

1. The existing 480-volt switchgear in the MPTP Electrical Building is General Electric Spectra Series.
2. The existing 480-volt switchgear in the RWTS Electrical Building is Eaton Cutler-Hammer.

Item No. AD1-35: Plant Overall One-Line Diagram Revised (Sheet E-14)

The One-Line Diagram should have a 600 amp, 480 volt, fusible disconnect switch on the secondary feeder of the 300 kVA transformer between the transformer and transfer switch. Fuse at 450 amp.

Item No. AD1-36: Control Schematics (Sheet E-15)

The power monitor shown for the Transfer Pump Control Schematic is specified in Section 11230, Article 2.04. As specified, it is equal to a "SundGard Power Monitor PM-2000". The monitor is DIN Rail mounted, 2.76" x 3.38" x 2.28". The display is panel mounted, 2.83" x 2.83" x 2.7". The Electrical Contractor is to verify actual unit and dimensions with the supplier.

Item No. AD1-37: Miscellaneous Details and Underground Conduit and Wire Schedule (Sheet E-17)

Change Tag Note 3 to: 2 - 3" conduits, each with 4-#4/0, 1-#2 Ground.

END OF ADDENDUM NO. 1

103 KAR 30:120. Machinery for new and expanded industry.

RELATES TO: KRS 139.170, 139.480

STATUTORY AUTHORITY: KRS Chapter 13A

NECESSITY, FUNCTION, AND CONFORMITY: To interpret the sales and use tax law as it applies to exemption qualification for "machinery for new and expanded industry."

Section 1. Requirements for Exemption. The machinery and the appurtenant equipment necessary to the completed installation of such machinery, together with the materials directly used in the installation of such machinery and appurtenant equipment, which are incorporated for the first time into new or existing plant facilities, or which are installed in the place of existing plant machinery having a lesser productive capacity, and which are directly used in a manufacturing or processing production operation shall be exempt from the sales and use tax. The term "processing production" shall include: the processing and packaging of raw materials, in-process materials, and finished products; the processing and packaging of farm and dairy products for sale; and the extraction of minerals, ores, coal, clay, stone and natural gas. In summary, the following four (4) specific requirements must be met before machinery qualifies for exemption:

- (1) It must be machinery.
- (2) It must be used directly in the manufacturing process.
- (3) It must be incorporated for the first time into plant facilities established in this state.
- (4) It must not replace other machinery.

Section 2. Analysis of Requirements. (1) It must be machinery. The term "machinery" shall mean: machines, in general, or collectively; also, the working parts of a machine, engine, or instrument; as, the machinery of a watch. (Webster's New International Dictionary). This definition does not specify that machinery must have working parts and be able to perform a function in and of itself, as a "machine" would. The machinery of a manufacturing operation is composed of all the components making up the process, including the fixed and nonmoving parts as well as the moving parts. This is illustrated in the example of the machinery of a watch.

(2) It must be used directly in the manufacturing process. Machinery must be intimately involved in production in order to be considered used "directly" in the manufacturing process. The fact that machinery is necessary for a manufacturing process does not automatically qualify it for exemption. A single manufacturer may, within his primary manufacturing process, have more than one (1) production activity.

(a) Primary manufacturing process.

1. The primary manufacturing process is the production operation resulting in a finished product which will be transferred from the producing plant for distribution to customers or for further processing at another plant site. Production begins at a point where the raw material enters a process and is acted upon to change its size, shape, or composition or is transformed in some manner. Production ends when the finished goods are packaged or ready for sale. Packaging is considered complete when the product is in the container in which it is normally received by the purchaser.

2. All activities preceding the point of introduction of the raw material into the manufacturing process and following the point at which the finished product is packaged or ready for sale are not production activities and the machinery used therein is subject to tax.

3. Storage facilities, including those provided for the storage of in-process materials which have been removed from the production line to await further processing, are not used directly in the manufacturing process and are subject to tax. Proximity of storage facilities to the production line is immaterial.

(b) Contributory or secondary manufacturing process. This activity generally falls into one (1) of four (4) categories:

1. The manufacture of industrial tools to be used in the manufacturing process. Examples include the manufacture of dies, patterns, rolls, molds, cutters and cutter blades, and like property. The exemption for machinery used herein is determined by the same criteria used for determining the exemption provided in the primary manufacturing process.

2. The processing of materials which do not become an ingredient of the finished product but are consumed as industrial supplies directly in the primary manufacturing process. Examples include water cooling systems, bottle washing preparatory to filling, and chemical processes whereby the chemical is used as a catalyst directly on the product being manufactured. This machinery exemption begins at the point where the material is acted upon to condition it for use in the manufacturing process or at the point where it performs a function itself, if it is not acted upon prior to that point. The exemption ends when the material leaves the process.

3. Electrical machinery and similar equipment used directly in the operation of other machinery which is used directly in the manufacturing process.

4. Machinery used exclusively for quality control of in-process material or the efficient operation of machinery. Examples are air cooling or

air conditioning systems, control panels, exhaust systems, and similar activities.

(3) It must be incorporated for the first time into plant facilities established in this state. To meet this requirement, the machinery must be installed in this state for the first time and it must be incorporated into plant facilities in this state. Machinery which has been once installed into manufacturing facilities in this state may be subject to tax as provided in 103 KAR 30:200 when subsequently sold by that manufacturer. Machinery purchased and delivered in Kentucky is subject to tax when the machinery is not acquired for installation in Kentucky.

(4) It must not replace other machinery. New machinery purchased to replace other machinery in the plant is subject to tax unless the new machinery performs a different function, manufactures a different product, or has a greater productive capacity, measured by units of production, than the machinery replaced. Modification of machinery to perform a different function or manufacture a different product qualifies for exemption.

Section 3. In all cases where a question arises concerning the exemption of machinery for new and expanded industry, the burden of proof that each qualification has been met is upon the one seeking the exemption. (SU-6-1; 1 Ky.R. 469; eff. 3-12-75.)

139.170 Definitions.

- (1) "Machinery for new and expanded industry" means machinery:
- (a) Used directly in a manufacturing or processing production process;
 - (b) Which is incorporated for the first time into a plant facility established in this state; and
 - (c) Which does not replace machinery in the plant facility unless that machinery purchased to replace existing machinery:
 1. Increases the consumption of recycled materials at the plant facility by not less than ten percent (10%);
 2. Performs different functions;
 3. Is used to manufacture a different product; or
 4. Has a greater productive capacity, as measured in units of production, than the machinery being replaced.

The term "machinery for new and expanded industry" does not include repair, replacement, or spare parts of any kind regardless of whether the purchase of repair, replacement, or spare parts is required by the manufacturer or vendor as a condition of sale or as a condition of warranty. The term "processing production" shall include the processing and packaging of raw materials, in-process materials, and finished products; the processing and packaging of farm and dairy products for sale; and the extraction of minerals, ores, coal, clay, stone, and natural gas.

- (2) "Manufacturing" for the purposes of this section only means any process through which material having little or no commercial value for its intended use before processing has appreciable commercial value for its intended use after processing by the machinery. The manufacturing or processing production process commences with the movement of raw materials from storage into a continuous, unbroken, integrated process and ends when the product being manufactured is packaged and ready for sale.
- (3) "Plant facility" means a single location that is exclusively dedicated to manufacturing or processing production activities. For purposes of this section, a location shall be deemed to be exclusively dedicated to manufacturing activities even if retail sales are made there, provided that the retail sales are incidental to the manufacturing activities occurring at the location. The term "plant facility" shall not include any restaurant, grocery store, shopping center, or other retail establishment.
- (4) "Repair, replacement, or spare parts" means any tangible personal property used to maintain, restore, mend, or repair machinery or equipment. "Repair, replacement, or spare parts" does not include machine oils, grease, or industrial tools.
- (5) "Recycled materials" means materials which have been recovered or diverted from the solid waste stream and reused or returned to use in the form of raw materials or products.

Effective: March 15, 2001

History: Amended 2001 Ky. Acts ch. 68, sec. 1, effective March 15, 2001. -- Amended 1994 Ky. Acts ch. 501, sec. 1, effective July 15, 1994. -- Amended 1991 (1st Extra.

Section 00300

BID FORM

PROJECT IDENTIFICATION:

Memorial Parkway Treatment Plant Improvements

THIS BID IS SUBMITTED TO:

Northern Kentucky Water District
2835 Crescent Springs Road
Erlanger, Kentucky 41018

1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Contract Documents to perform all Work as specified or indicated in the Contract Documents within the time indicated and for the amount indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

2. Bidder accepts all of the terms and conditions of the Invitation to Bid and the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 90 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner. Bidder understands that certain extensions to the time for acceptance of this Bid may require the consent of the surety for the Bid Bond.

3. In submitting this Bid, Bidder represents and covenants, as set forth in the Agreement, that:

a. Bidder has examined and carefully studied the Contract Documents, the other related data identified in the Contract Documents, and the following Addenda, receipt of all of which is hereby acknowledged:

No. _____ Dated _____

No. _____ Dated _____

No. _____ Dated _____

No. _____ Dated _____

No. _____ Dated _____

No. _____ Dated _____

b. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

- c. Bidder is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.
 - d. Bidder has obtained and carefully studied (or assumes responsibility for having done so) all additional or supplementary explorations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents to be employed by Bidder, and safety precautions and programs incident thereto.
 - e. Bidder does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Contract Documents.
 - f. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
 - g. Bidder has correlated the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.
 - h. Bidder has given Owner written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Contract Documents, and the written resolution thereof by Owner is acceptable to Bidder.
 - i. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.
4. Bidder further represents that this Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization, or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any individual or entity to refrain from bidding; and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over Owner.

5. Bidder will complete the Work for the following price:

*** BASE BID ***

ITEM 1 – Furnishing all products, materials and equipment and performing all labor necessary to complete and put into operation the Memorial Parkway Treatment Plant Improvements, including all work shown on the Drawings and/or specified and not included in Item 2 below, nor the Alternate the amount of: \$_____ (in numbers) and

_____ DOLLARS (in words).

ITEM 2 - CONCRETE RESTORATION

a.	800	SQ.FT.	Interior Vertical Surfaces	\$_____/SF	\$_____
b.	600	SQ.FT.	Exterior Vertical Surfaces	\$_____/SF	\$_____
c.	1,800	SQ.FT.	Underside of Beams and Slabs	\$_____/SF	\$_____

BASE BID TOTAL, ITEMS 1 THROUGH 2, INCLUSIVE, THE AMOUNT OF \$ _____
_____ (in numbers) and _____

_____ DOLLARS (in words).

*** ALTERNATE BID ***

Add, for constructing the powdered activated carbon feed system housed in a pre-engineered metal building as shown on the Drawings and as specified, the Lump Sum Amount of \$ _____ (in numbers) and _____

_____ DOLLARS (in words).

6. Bidder agrees that the Work will be substantially complete within 330 calendar days, and completed and ready for final payment in accordance with paragraph 14.07.B of the General Conditions within 360 calendar days, after the date when the Contract Times commence to run as defined in the General Conditions.

7. Communications concerning this Bid shall be sent to Bidder at the following address:

8. The terms used in this Bid, which are defined in the General Conditions included as part of the Contract Documents, have the meanings assigned to them in the General Conditions.

9. The Bidder shall designate below the one manufacturer for each product to be furnished and installed if awarded the Work. The Bidder understands that if this information is not provided or Bidder does not offer products meeting all Specification requirements and having the approval of the Engineer, then the Owner reserves the right either to determine the Bidder non-responsive and reject the Bid or to designate the manufacturer of the products to be provided which will meet all specification requirements, which Owner-designated manufacturer products must be furnished by the Bidder at no increase in the Contract Price.

SIGNATURE OF BIDDER

If an Individual

Name (typed or printed): _____

By _____ (SEAL)
(Individual's signature)

doing business as _____

Business address _____

Phone No.: _____ Fax No.: _____

Date _____

If a Partnership

Partnership Name: _____ (SEAL)

By _____
(Signature of general partner - attach evidence of authority to sign)

Name (typed or printed): _____

Business address _____

Phone No. _____ Fax No.: _____

Date _____

If a Corporation

Corporation Name: _____ (SEAL)

State of Incorporation: _____

Type (General, Professional, Service, Limited Liability): _____

By _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

(CORPORATE SEAL)

Attest _____

Business address _____

Phone No. _____ Fax No.: _____

Date _____

If a Joint Venture

(Each joint venturer must sign. The manner for signing for each individual, partnership, and corporation that is party to the joint venture should be in the manner indicated above.)

Joint Venturer Name: _____ (SEAL)

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

Phone No.: _____ Fax No.: _____

Joint Venturer Name: _____ (SEAL)

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

Phone No.: _____ Fax No.: _____

Date _____

Section 00400

SUPPLEMENT TO BID FORM

1. FORMS TO BE SUBMITTED WITH BID. A portion of the funding for this project comes from a Drinking Water State Revolving Fund (DWSRF) loan. This loan originates with the United States Environmental Protection (USEPA) and has several provisions that directly impact the Bidder. The items identified in Item 1 of this section must be submitted with the Bid. These include:

- a. A certification that the Bidder, and any subcontractors used by the Bidder, are not on the Federal List of Debarred Contractors. Attachment No. 1 (CERTIFICATION REGARDING DEBARMENT, SUSPENSION AND OTHER MATTERS – EPA Form 5700-49) in Section 00400 addresses this item and must be executed and included with the Bid.
- b. A certification by the Bidder that no appropriated funds were or will be used for the purposes of lobbying the legislative or executive branches of the Federal government. Attachment No. 2 (CERTIFICATION REGARDING LOBBYING) in Section 00400 addresses this item and must be submitted with the Bid.
- c. A requirement to utilize minority or women owned businesses as subcontractors where possible. Bidders are required to make positive efforts towards this end and document the steps taken to encourage their participation. Attachment No. 3 (MBE/WBE DATA SHEET I) in Section 00400 addresses this item and must be filled out and submitted with the Bid.

2. FORMS TO BE SUBMITTED BY APPARENT LOW BIDDER AFTER BID OPENING. The DWSRF loan creates additional documentation requirements on both the Contractor and the Owner. These are set forth in the Supplemental General Conditions for Drinking Water State Revolving Fund Loans (DWSRF Supplemental General Conditions). The remaining items identified in the DWSRF Supplemental General Conditions Section will be submitted by the apparent low bidder within 21 days of the Bid opening. The project will not be awarded until this information is received.

CERTIFICATIONS

Debarred Firms

All prime Construction Contractors shall certify that Subcontractors have not and will not be awarded to any firm that is currently on the EPA Master List of Debarred, Suspended and Voluntarily Excluded Persons in accordance with the provisions of 40 CFR 32.500(c). Debarment action is taken against a firm for noncompliance with Federal Law.

All bidders shall complete the attached certification (Attachment Number 10) and submit to the owner with the bid proposal.

Anti-lobbying Certification

All prime Construction Contractors must certify (Attachment Number 11) that no appropriated funds were or will be expended for the purpose of lobbying the Executive or Legislative Branches of the Federal Government or Federal Agency concerning this contract (contract in excess of \$100,000). If the Contractor has made or agreed to make payment to influence any member of Congress in regard to award of this contract, a Disclosure Form must be completed and submitted to the owner with the bid proposal.

All prime Contractors must require all Subcontractors to submit the certification, which must also be submitted to the owner.

**CERTIFICATION REGARDING DEBARMENT,
SUSPENSION AND OTHER RESPONSIBILITY MATTERS**

The prospective participant certifies to the best of its knowledge and belief that it and its principals:

(A) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(b) Have not within a three year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. In addition, under 18 USC Sec. 1001, a false statement may result in a fine of up to \$10,000 or imprisonment for up to 5 years, or both.

Typed Name & Title of Authorized Representative

Signature of Authorized Representative

Date

_____ I am unable to certify to the above statements. My explanation is attached.

CERTIFICATION REGARDING LOBBYING
Certification for Contracts, Grants,
Loans, and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

TYPED NAME & TITLE OF AUTHORIZED REPRESENTATIVE

SIGNATURE OF AUTHORIZED REPRESENTATIVE DATE

_____ I am unable to certify to the above statements. My explanation is attached.

UTILIZATION OF SMALL, MINORITY AND WOMEN'S BUSINESSES

The provisions of PL 102-389 and EPA's implementing regulation 40 CFR 31.36(e) require recipients of Federal assistance to award a fair share of sub-agreements to small, small rural, minority and women's businesses on contracts and sub-agreement performed under EPA Assistance Agreements.

The following procedures are to be followed for procurement under EPA Assistance Agreements.

The successful bidder must submit to the grantee within 10 days after bid opening, evidence of the positive steps taken to utilize small, minority and women's businesses. Information should include the following:

EPA Project Number. Project Location. Type of Construction.

List of current construction contracts, with dollar amount. List contracting Federal Agency, if applicable.

List of subcontractors (name, address and telephone) with dollar amount and duration of subcontract.

List of any subcontract work yet to be committed with estimate of dollar amount and duration of contract.

Contract Price. Duration of prime contract.

Such positive efforts shall include:

- (1) Placing qualified small and minority businesses and women's business enterprises on solicitation lists;
- (2) Assuring that small and minority businesses, and women's business enterprises are solicited whenever they are potential sources;
- (3) Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority business, and women's business enterprises;
- (4) Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority business, and women's business enterprises;
- (5) Using the services and assistance of the Small Business Administration, and the Minority Business Development Agency of the Department of Commerce; and
- (6) Requiring each party to a sub-agreement to take the affirmative steps listed in paragraphs 1 through 5 of this section.

For purposes of clarification:

" This requirement applies to any EPA Financially assisted procurement.

" This requirement mandates three responsibilities. Separate solicitations must be made of small, small rural, minority and women's businesses enterprises.

" A minority business is a business, at least 51 percent of which is owned and controlled by minority group members (Black; Hispanic; Asian American; American Indian; and any other designations approved by the Office of Management and Budget that are U.S. citizens. Any specific clarification concerning the ownership and/or control issues will be provided by the EPA Regional Office.

" A women's business is a business, at least 51 percent of which is owned and controlled by one or more women who are U.S. citizens.

" The control determination will revolve around the minority or women owner's involvement in the day-to-day management of the business enterprise.

" Solicitation should allow adequate time for price analysis; EPA recommends that contact be made no later than 15 days before bid opening.

" Efforts taken to comply with this requirement must be documented in detail; maintain records of firms contacted, including any negotiation efforts to reach competitive price levels, and awards to the designated firms.

" Any proposed changes from the approved Minority/Women/Small business participation after EEO/MBE approval shall be reported to EPA prior to initiation of the action, with the reason for the proposed deviation.

" The EPA recommends that the grantee as well as the prime contractor utilize the services of the following agencies to find information on certified Minority/Women/Small business. Use of these services does not absolve the prime contractors from pursuing additional efforts to comply with this requirement.

Minority Business Development Service Centers These Centers are funded by the U.S. Department of Commerce to provide technical, financial and contracting assistance to minority, women's and small rural business enterprises. The locations of the Centers are available by selecting the appropriate Minority Business Development Agency regional office from: <http://www.mbda.gov/>.

U.S. Small Business Administration Central Contractor Registration (procurement marketing and access network) at <http://www.ccr.gov/>.

U.S. Small Business Administration (SBA) Online Women's Business Center. For the Women's Business Center nearest you, go to: <http://www.onlinewbc.gov/> and select Women's Business Centers.

For additional information on listings of certified MBE/WBE contractors and subcontractors in the States of Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee, contact Rafael Santamaria in EPA Region 4 at 404 562-8312.

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS, that we, _____, as Principal, and _____, as Surety, are held and firmly bound unto the Northern Kentucky Water District in the sum of _____ Dollars (\$ _____) lawful money of the United States of America, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, personal representatives, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted to the Owner a Bid for construction of Memorial Parkway Treatment Plant Improvements.

NOW THEREFORE, the conditions of this obligation are such that if the Bid be accepted, the Principal shall, within ten days after receipt of conformed Contract Documents, execute a Contract in accordance with the Bid upon the terms, conditions and prices set forth therein, and in the form and manner required by the Contract Documents and execute sufficient and satisfactory separate Performance and Payment Bonds payable to the Owner, each in an amount of 100 percent of the total Contract Price, in form satisfactory to the Owner, then this obligation shall be void; otherwise, it shall be and remain in full force and effect in law; and the Surety shall, upon failure of the Principal to comply with any or all of the foregoing requirements within the time specified above, immediately pay to the aforesaid Owner, upon demand, the amount hereof in good and lawful money of the United States of America, not as a penalty, but as liquidated damages.

IN WITNESS WHEREOF, the said Principal has hereunder affixed its signature and seal, and said Surety has hereunto caused to be affixed its corporate signature and seal, by its duly authorized officers, on this _____ day of _____, 200_____.

CONTRACTOR – PRINCIPAL:

By: _____
(name signed)

(name printed or typed)

Title: _____

Address: _____

Attest: _____

(name signed)

(name printed or typed)

Title: _____

(SEAL)

Note: Attest for a corporation must be by the corporate secretary; for a partnership by another partner; for an individual by a notary.

SURETY:

By: _____

(name signed)

(name printed or typed)

Title: _____

Address: _____

Attest: _____

(name signed)

(name printed or typed)

Title: _____

(SEAL)

Note: Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the Project is located.

END OF SECTION

Statement of Bidder's Qualifications

All questions must be answered and the data given must be clear and comprehensive. This statement must be notarized. If necessary, questions may be answered on separate attached sheets. The Bidder may submit any additional information desired. Attach all additional sheets to this statement. (Sample "Project Information Form" contained at the end of this Section.)

1. Name of Bidder: _____
2. Permanent main office address and phone number: _____

3. When organized: _____
4. If a Corporation, where incorporated: _____
5. How many years have you been engaged in the contracting business under your present firm or trade name? _____
6. Contracts on hand. (Complete a "Project Information Form", for each Contract on hand.)
7. General description of type of work performed by your company: _____

8. Have you ever failed to complete any work awarded to you? If so, where and why? _____

9. Have you ever defaulted on a contract? If so, where and why? _____

10. Attach a list of the most important projects recently completed by your company which are similar in scope to this Project. (Complete a "Project Information Form", for each Project listed.)
11. Names, background and experience of the principal members of your organization, including officers:

Name	Position	Years Experience
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Statement of Bidder's Qualifications

12. The undersigned hereby authorizes and requests any person, firm, or corporation to furnish any information requested by the Owner in verification of the recitals comprising this Statement of Bidder's Qualifications.

I, _____, certify that I am _____ of the Bidder, and that the answers to the foregoing questions and statements contained therein are true and correct.

BIDDER: _____

By: _____

(name signed)

(name printed or typed)

Title: _____

Date: _____

Subscribed and sworn to me this ___ day of _____, 200__.

NOTARY PUBLIC: _____

(name signed)

(name printed or typed)

Commission Expires: _____

(Date)

(SEAL)

Project Information Form

Project Title: _____

Project Description: _____

Project Owner:

- Owner Name: _____
- Contact Person: _____
- Phone Number: _____

Engineer/Construction Manager:

- Company Name: _____
- Contact Person: _____
- Phone Number: _____

Contract Amount:

- Initial: _____
- Final: _____

Contract Time

- Initial: _____
- Final: _____
- Completion Date: _____

END OF SECTION

Proposed Subcontractors

The Bidder shall list all subcontractors, providing subcontracting services, in excess of \$50,000 (but is not required to list those only furnishing products or materials), to be utilized in the performance of the work. If the Bidder intends to self-perform the indicated work, the Bidder shall write "Self-Perform" on such line. This list shall be submitted in the following format:

Subcontractor (Name & City, State)	Nature of Work to be Contracted
	Electrical
	Plumbing
	Grading
	Painting
	Heating, Ventilation, Air Conditioning
	Concrete Placement
	Masonry
	Concrete Restoration
	Instrumentation And Control

The Bidder shall designate below the one manufacturer for each product to be furnished and installed if awarded the Work. The Bidder understands that if this information is not provided or Bidder does not offer products meeting all Specification requirements and having the approval of the Engineer, then the Owner reserves the right either to determine the Bidder non-responsive and reject the Bid or to designate the manufacturer of the products to be provided which will meet all specification requirements, which Owner-designated manufacturer products must be furnished by the Bidder at no increase in the Contract Price.

1. Product: Peristaltic Type Hose Pumps
Manufacturer: _____
Model No.: _____

2. Product: Horizontal Split Case Centrifugal Pumps
Manufacturer: _____
Model No.: _____

3. Product: Powdered Activated Carbon Feed System
Manufacturer: _____
Model No.: _____

4. Product: Fiberglass Storage Tanks
Manufacturer: _____
Model No.: _____

5. Product: Water Filter and Appurtenances
Manufacturer: _____
Model No.: _____

NOTE: Any proposed changes from the above list shall be submitted in writing to the Owner prior to initiation of the action, with the reason for the proposed deviation.

END OF SECTION

Section 00460

NON-COLLUSION AFFIDAVIT

STATE OF: _____)

COUNTY OF: _____) SS

_____, being first duly sworn, deposes

and says that he/she is the _____ of
(sole owner, a partner, president, secretary, etc.)

_____, the party making the foregoing bid; that such bid is genuine and not collusive or sham; that said bidder is not financially interested in, or otherwise affiliated in a business way with any other bidder on the same contract; that said bidder has not colluded, conspired, connived, or agreed, directly or indirectly, with any bidder or person, to put in a sham bid, or that such other person shall refrain from bidding, and has not in any manner directly or indirectly sought by agreement or collusion, or communication or conference, with any person, to fix the price or affidavit of any other bidder, or that of any other bidder, or to secure any advantage against Owner, or any person or persons interested in the proposed Contract; and that all statements contained in said bid are true; and further, that such bidder has not, directly or indirectly submitted this bid, or the contents thereof, or divulged information of data relative thereto to any association or to any member or agent thereof.

AFFIANT

Sworn to and subscribed before me, a Notary Public in and for the above named

State and County, this _____ day of _____, 20 ____.

NOTARY PUBLIC

End of Section



Ernie Fletcher
Governor

ENVIRONMENTAL AND PUBLIC PROTECTION CABINET
DEPARTMENT OF LABOR

OFFICE OF WORKPLACE STANDARDS
1047 US Hwy 127 S STE 4
Frankfort, Kentucky 40601
Phone: (502) 564-3070
www.labor.ky.gov

LaJuana S. Wilcher
Secretary

Philip J. Anderson
Commissioner

Christopher H. Smith
Executive Director

July 6, 2006

Brent Tippey
Quest Engineers, Inc.
2517 Sir Barton Way
Lexington KY 40509

Re: Northern Kentucky Water District, Memorial Parkway Treatment Plant Improvements

Advertising Date as Shown on Notification: July 13, 2006

Dear Brent Tippey:

This office is in receipt of your written notification on the above project as required by KRS 337.510 (1).

I am enclosing a copy of the current prevailing wage determination number CR-1-024, dated January 25, 2006 for CAMPBELL County. This schedule of wages shall be attached to and made a part of the specifications for the work, printed on the bidding blanks, and made a part of the contract for the construction of the public works between the public authority and the successful bidder or bidders.

The determination number assigned to this project is based upon the advertising date contained in your notification. There may be modifications to this wage determination prior to the advertising date indicated. In addition, if the contract is not awarded within 90 days of this advertising date or if the advertising date is modified, a different set of prevailing rates of wages may be applicable. It will be the responsibility of the public authority to contact this office and verify the correct schedule of the prevailing rates of wages for use on the project. Your project number is as follows:
019-H-00225-06-1, Heavy/Highway

Sincerely,

John Fitzpatrick
Prevailing Wage Specialist

KENTUCKY DEPARTMENT OF LABOR
PREVAILING WAGE DETERMINATION
CURRENT REVISION
LOCALITY 24

CAMPBELL & PENDLETON COUNTIES

Determination No. CR-1-024 2006

Date of Determination: January 25, 2006

Project No. 019-H-00225-06-1 Type: ___ Bldg <u>XXX</u> HH
--

This schedule of the prevailing rate of wages for Campbell & Pendleton Counties has been determined in accordance with the provisions of KRS 337.505 to 337.550. This determination shall be referred to as Prevailing Wage Determination No. CR-1-024 2006.

Apprentices shall be permitted to work as such subject to Administrative Regulations adopted by the Executive Director of Workplace Standards. Copies of these regulations will be furnished upon request to any interested person.

Overtime is to be computed at not less than one and one-half (1 1/2) times the indicated BASE RATE for all hours worked in excess of eight (8) per day, and/or in excess of forty (40) per week. However, KRS 337.540 permits an employee and employer to agree, in writing, that the employee will be compensated at a straight time base rate for hours worked in excess of eight (8) hours in any one calendar day, but not more than ten (10) hours worked in any one calendar day, if such written agreement is prior to the over eight (8) hours in a calendar day actually being worked, or where provided for in a collective bargaining agreement. The fringe benefit rate is to be paid for each hour worked at a straight time rate for all hours worked.

Fringe benefit amounts are applicable for all hours worked except when otherwise noted. Welders will receive rate for craft in which welding is incidental.

NOTE: The type of construction shall be determined by applying the following definitions:

BUILDING CONSTRUCTION

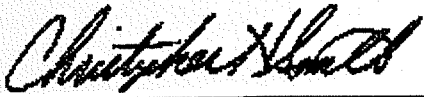
Building construction is the construction of sheltered enclosures with walk-in access for the purpose of housing persons, machinery, equipment, or supplies. It includes all construction of such structures, the installation of utilities and the installation of equipment, both above and below grade level, as well as incidental grading, utilities and paving.

HIGHWAY CONSTRUCTION

Highway construction includes the construction, alteration or repair of roads, streets, highways, runways, taxiways, alleys, trails, paths, parking areas, and other similar projects not incidental to building or heavy construction. It includes all incidental construction in conjunction with the highway construction project.

HEAVY CONSTRUCTION

Heavy projects are those projects that are not properly classified as either "building" or "highway". For example, dredging projects, water and sewer line projects, dams, flood control projects, sewage treatment plants and facilities, and water treatment plants and facilities are considered heavy.



Christopher H. Smith, Executive Director
Office of Workplace Standards
Kentucky Department of Labor

Determination No. CR-1-024 2006
January 25, 2006

CAMPBELL & PENDLETON COUNTIES:

ASBESTOS/INSULATION WORKERS:

Asbestos/Insulation Workers: (Includes application of all insulating materials, protective coverings, coatings & finishing to all types of mechanical systems):

BASE RATE \$23.18
FRINGE BENEFITS 10.44

Hazardous Material Handler ((Includes preparation, wetting, stripping, removal, scrapping, vacuuming, bagging and disposing of all insulation materials, whether they contain asbestos or not, from mechanical systems):

BASE RATE \$19.60
FRINGE BENEFITS 7.00

CAMPBELL & PENDLETON COUNTIES:

BOILERMAKERS:

BASE RATE \$31.29
FRINGE BENEFITS 16.67

CAMPBELL & PENDLETON COUNTIES:

BRICKLAYERS:

Bricklayers, Caulkers, Cleaners, Pointers & Stonemasons:

BASE RATE \$25.16
FRINGE BENEFITS 8.39

Refractory:

BASE RATE \$25.66
FRINGE BENEFITS 8.39

Marble Setters, Terrazzo Workers & Tile Setters:
BUILDING

BASE RATE \$25.92
FRINGE BENEFITS 7.84

Marble Terrazzo & Tile Finishers: BUILDING

BASE RATE \$21.48
FRINGE BENEFITS 7.84

Marble Sanders, Polishers, Waxers, & Sawyers:
BUILDING

BASE RATE \$21.55
FRINGE BENEFITS 7.84

Terrazzo Base Grinders (While operating base grinding machine):
BUILDING

BASE RATE \$21.90
FRINGE BENEFITS 7.84

CAMPBELL & PENDLETON COUNTIES:

CARPENTERS:

Carpenters & Piledrivermen (Does not include Walls & Ceiling Work):

BUILDING	BASE RATE	\$19.22
	FRINGE BENEFITS	4.77

Carpenters & Lathers (Walls & Ceiling Work Only):

BUILDING	BASE RATE	\$18.99
	FRINGE BENEFITS	4.98

Carpenters & Piledrivermen:

HEAVY & HIGHWAY	BASE RATE	\$22.42
	FRINGE BENEFITS	4.73

Divers:

HEAVY & HIGHWAY	BASE RATE	\$33.63
	FRINGE BENEFITS	4.73

CAMPBELL & PENDLETON COUNTIES:

CEMENT MASONS:

BUILDING	BASE RATE	\$21.00
	FRINGE BENEFITS	7.50

HEAVY & HIGHWAY	BASE RATE	\$24.18
	FRINGE BENEFITS	7.35

CAMPBELL & PENDLETON COUNTIES:

ELECTRICIANS:

Electricians:

	BASE RATE	\$24.24
	FRINGE BENEFITS	9.34

LINE CONSTRUCTION:

Lineman:

BUILDING	BASE RATE	\$24.10
	FRINGE BENEFITS	6.66

Equipment Operator:

BUILDING	BASE RATE	\$21.69
	FRINGE BENEFITS	6.21

Groundman:

BUILDING	BASE RATE	\$15.67
	FRINGE BENEFITS	5.10

SOUND COMMUNICATIONS:

Installer:

	BASE RATE	\$18.00
	FRINGE BENEFITS	3.475

Cable Puller:

	BASE RATE	\$9.00
	FRINGE BENEFITS	2.64

CAMPBELL & PENDLETON COUNTIES:

ELEVATOR MECHANICS:	BASE RATE	\$30.775
	FRINGE BENEFITS	12.015

CAMPBELL & PENDLETON COUNTIES:

GLAZIERS:	BASE RATE	\$22.05
	FRINGE BENEFITS	7.90

CAMPBELL & PENDLETON COUNTIES:

IRONWORKERS:

Ornamental & Structural:	BASE RATE	\$24.00
	FRINGE BENEFITS	14.10

Fence Erector:	BASE RATE	\$21.60
	FRINGE BENEFITS	14.10

Reinforcing: Beyond 30-mile radius of Hamilton County, OH Courthouse	BASE RATE	\$24.70
	FRINGE BENEFITS	12.85

Up to and including 30-mile radius of Hamilton County, OH Courthouse	BASE RATE	\$24.45
	FRINGE BENEFITS	12.85

CAMPBELL COUNTY:

LABORERS/BUILDING:

Building & Common Laborer, Cement Mason Tender, Hand Operated Mechanical Mule, Mechanical Sweeper, Signal Person, Asbestos Removal, & Tunnel Laborer:

BUILDING	BASE RATE	\$21.30
	FRINGE BENEFITS	5.85

Skid Steer, Burning Torch Operator, Jackhammer, Air Spade, Chipping Hammer, Mechanical & Air Tamper Operator, Mechanical Concrete Buggy, Power Operated Mechanical Mule, Concrete Pump Hose Man, Vibrator Man, CERCLA Trained Hazardous Material Removal – Levels A, B, C:

BUILDING	BASE RATE	\$21.45
	FRINGE BENEFITS	5.85

CAMPBELL COUNTY:

LABORERS/BUILDING:(Continued)

Gunnite Nozzle Operator:	BUILDING	BASE RATE	\$22.05
		FRINGE BENEFITS	5.85
Brick Mason Tender:	BUILDING	BASE RATE	\$23.00
		FRINGE BENEFITS	5.85

LABORERS/HEAVY HIGHWAY:

GROUP 1:

Asphalt Laborer; Carpenter Tender; Concrete Curing applicator; Dump Man (Batch Truck); Guardrail and Fence Installer; Joint Setter; Laborer (Construction); Landscape Laborer; Mesh Handlers & Placer; Right-of way Laborer; Riprap Laborer & Grouter; Scaffold Erector; Seal Coating; Surface Treatment or Road Mix Laborer; Sign Installer; Slurry Seal; Utility Man; Bridge Man; Handyman; Waterproofing Laborer; Flagperson; Hazardous Waste (Level D); Diver Tender; Zone Person & Traffic Control:

HEAVY & HIGHWAY	*BASE RATE	\$22.72
	FRINGE BENEFITS	5.85

GROUP 2:

Skid Steer; Asphalt Raker; Concrete Puddler; Kettle Man (Pipeline); Machine Driven Tools (Gas, Electric, Air); Mason Tender; Brick Paver; Mortar Mixer; Power Buggy or Power Wheelbarrow; Sheeting & Shoring Man; Surface Grinder Man; Plastic Fusing Machine Operator; Pug Mill Operator; & Vacuum Devices (wet or dry); Rodding Machine Operator; Diver; Screwman or Paver; Screed Person; Water Blast, Hand Held Wand; Pumps 4" & Under (Gas, Air or Electric) & Hazardous Waste (Level C); Air Track and Wagon Drill; Bottom Person; Cofferdam (below 25 ft. deep); Concrete Saw Person; Cutting with Burning Torch; Form Setter; Hand Spiker (Railroad); Pipelayer; Tunnel Laborer (without air) & Caisson; Underground Person (working in Sewer & Waterline, Cleaning, Repairing & Reconditioning); Sandblaster Nozzle Person; & Hazardous Waste (Level B):

HEAVY & HIGHWAY	*BASE RATE	\$22.89
	FRINGE BENEFITS	5.85

GROUP 3:

Blaster; Mucker; Powder Person; Top Lander; Wrencher (Mechanical Joints & Utility Pipeline); Yarner; Hazardous Waste (Level A); Concrete Crew in Tunnels (With air-pressurized - \$1.00 premium); Curb Setter & Cutter; Grade Checker; Utility Pipeline Tapper; Waterline; and Caulker:

HEAVY & HIGHWAY	*BASE RATE	\$23.22
	FRINGE BENEFITS	5.85

GROUP 4:

Miner (With Air-pressurized - \$1.00 premium); & Gunnite Nozzle Person:

HEAVY & HIGHWAY	*BASE RATE	\$23.67
	FRINGE BENEFITS	5.85

***Signal Person will receive the rate equal to the rate paid the laborer classification for which he or she is signaling.**

PENDLETON COUNTY:

LABORERS/BUILDING:

GROUP 1:

Asbestos Abatement, Carpenter Tender, General, Concrete Pouring & Curing, Concrete Form Stripping & Wrecking, Hand Digging & Backfilling of Ditches, Clearing of Right-of-ways & Building Sites, Wood Sheeting & Shoring, Signalperson for Concrete Bucket, General Cleaning, Toxic Waste Removal, & Environmental Laborer – Nuclear, Radiation, Toxic & Hazardous Waste Level D:

BUILDING	BASE RATE	\$17.83
	FRINGE BENEFITS	7.08

GROUP 2:

Air Tool Operator, Air Track Drill, Asphalt Raker, Tamper, Batch Plant & Scale Man, Chain Saw, Concrete Saw, Electric Hand Grinder, Electric Bush & Chipping Hammer, Flagperson, Forklift Operator, Form Setter (Street or Highway), Gunnite, Hand Spiker, Introflax Burning Rod, Joint Maker, Mason Tender, Pipelayer, Plasterer Tender, Power Driven Georgia Buggy, Power Posthole Digger, Railroad, Sandblaster, Scow Man & Deck Hand, Signalperson, Sweeper & Cleaner Machine, Vibrator Operator, Walk Behind Trenching Machine, Mortar Mixer Machine, Water Pumpman, Metal Form Setter, Heater, Mesh Handler on walkways, Streets & Roadways (Outside Buildings), & Environmental Laborers – Nuclear, Radiation, Toxic & Hazardous Waste – Level C:

BUILDING	BASE RATE	\$18.23
	FRINGE BENEFITS	7.08

GROUP 3:

Gunnite Nozzleman & Gunnite Nozzle Machine Operator, Sand Blaster Nozzleman, Concrete or Grout Pumpman, & Plaster Pumpman:

BUILDING	BASE RATE	\$18.43
	FRINGE BENEFITS	7.08

GROUP 4:

Powderman & Blaster, & Environmental Laborer – Nuclear, Radiation, Toxic & Hazardous Waste – Level B:

BUILDING	BASE RATE	18.53
	FRINGE BENEFITS	7.08

GROUP 5:

Caisson Hole (6 ft & over – Pressure & Free Air Including Tools), Construction Specialist, & Environmental Laborer – Nuclear, Radiation, Toxic & Hazardous Waste – Level A:

BUILDING	BASE RATE	\$19.03
	FRINGE BENEFITS	7.08

PENDLETON COUNTY:

LABORERS/BUILDING (continued)

GROUP 6:

Tunnel Man & Tunnel Sand Miner, Cofferdam (Pressure & Free Air), & Sand Hog or Mucker (Pressure or Free Air):

BUILDING	BASE RATE	\$19.33
	FRINGE BENEFITS	7.08

HEAVY HIGHWAY:

Aging & Curing of Concrete; Asbestos Abatement Worker; Asphalt Plant; Asphalt; Batch Truck Dump; Carpenter Tender; Cement Mason Tender; Cleaning of Machines; Concrete; Demolition; Dredging; Environmental – Nuclear, Radiation, Toxic & Hazardous Waste – Level D; Flagperson; Grade Checker; Hand Digging & Hand Back Filling; Highway Marker Placer; Landscaping, Mesh Handler & Placer; Puddler; Railroad; Rip-rap & Grouter; Right-of-Way; Sign, Guard Rail & Fence Installer; Signal Person; Sound Barrier Installer; Storm & Sanitary Sewer; Swamper; Truck Spotter & Dumper; Wrecking of Concrete Forms; General Cleanup:

HEAVY & HIGHWAY	BASE RATE	\$18.08
	FRINGE BENEFITS	8.63

Batter Board Man (Sanitary & Storm Sewer); Brickmason Tender; Mortar Mixer Operator; Scaffold Builder; Burner & Welder; Bushhammer; Chain Saw Operator; Concrete Saw Operator; Deckhand Scow Man; Dry Cement Handler; Environmental – Nuclear, Radiation, Toxic & Hazardous Waste – Level C; Forklift Operator for Masonry; Form Setter; Green Concrete Cutting; Hand Operated Grouter & Grinder Machine Operator; Jackhammer; Pavement Breaker; Paving Joint Machine; Pipelayer; Plastic Pipe Fusion; Power Driven Georgia Buggy & Wheel Barrow; Power Post Hole Digger; Precast Manhole Setter; Walk-Behind Tamper; Walk-Behind Trencher; Sand Blaster; Concrete Chipper; Surface Grinder; Vibrator Operator; Wagon Driller:

HEAVY & HIGHWAY	BASE RATE	\$18.33
	FRINGE BENEFITS	8.63

Asphalt Luteman & Raker; Gunnite Nozzleman; Gunnite Operator & Mixer; Grout Pump Operator; Side Rail Setter; Rail Paved Ditches; Screw Operator; Tunnel (Free air); Water Blaster:

HEAVY & HIGHWAY	BASE RATE	\$18.38
	FRINGE BENEFITS	8.63

Caisson Worker (Free Air); Cement Finisher; Environmental - Nuclear, Radiation, Toxic & Hazardous Waste - Levels A & B; Miner & Driller (Free Air); Tunnel Blaster; & Tunnel Mucker (Free Air); Directional & Horizontal Boring; Air Track Driller (all types); Powderman & Blaster; Troxler & Concrete Tester if Laborer is Utilized:

HEAVY & HIGHWAY	BASE RATE	\$18.98
	FRINGE BENEFITS	8.63

CAMPBELL & PENDLETON COUNTIES:

MILLWRIGHTS:		BASE RATE	\$21.90
		FRINGE BENEFITS	7.92

CAMPBELL & PENDLETON COUNTIES:

OPERATING ENGINEERS/BUILDING:

Boom & Jib 250' & Over:	BUILDING	BASE RATE	\$28.04
		FRINGE BENEFITS	8.80
Boom & Jib Over 180' through 249':	BUILDING	BASE RATE	\$27.79
		FRINGE BENEFITS	8.80
Boom & Job 150' through 180':	BUILDING	BASE RATE	\$27.29
		FRINGE BENEFITS	8.80
Master Mechanic	BUILDING	BASE RATE	\$27.04
		FRINGE BENEFITS	8.80

Barrier Moving Machine; Boiler or Compressor Mounted on Crane (Piggy-Back Operation); Boom Truck; Cableway; Cherry Picker; Combination Concrete Mixer & Tower; Concrete Pump with Booms; Crane; Derrick; Dragline; Dredge (Dipper, Clam or Suction) 3 Man Crew; Elevating Grader or Euclid Loader; Floating Equipment; Forklift (rough terrain with winch/hoist); Gradeall; Helicopter Operator & Helicopter Winch Operator (Hoisting Builders Materials); Hoe; Hoist (Two or More Drums); Horizontal Directional Drill; Hydraulic Gantry (Lift System); Laser Finishing Machine; Laser Screed and Like Equipment; Lift Slab or Panel Jack; Locomotive; Maintenance Engineer (Mechanic); Mixer, Paving (Multiple Drum); Mobile Concrete Pump with Boom; Panelboard; Pile Driver; Power Shovel; Prentice Loader; Rail Tamper with automatic lifting & align device; Rotary Drill used on Caisson Work for Foundations & Substructure work; Side Boom; Slip Form Paver; Straddle Carrier; Trench Machine (Over 24" Wide); & Tug Boat:

BUILDING	BASE RATE	\$26.79
	FRINGE BENEFITS	8.80

Asphalt Paver; Bobcat-type and/or Skid Steer Loader with Hoe Attachment Greater than 7,000 lbs.; Bulldozer; C.M.I. Type Equipment; Concrete Grinder/Planer; Endloader; Hydro Milling Machine; Kolman Type Loader (Dirt Loading); Lead Greaseman; Mucking Machine; Pettibone-Rail Equipment; Power Grader; Power Scoop; Power Scraper; Push Cat; & Vermeer Type Concrete Saw:

BUILDING	BASE RATE	\$26.67
	FRINGE BENEFITS	8.80

CAMPBELL & PENDLETON COUNTIES:

OPERATING ENGINEERS/BUILDING (Continued):

A-Frame; Air Compressor Pressurizing Shafts or Tunnels; Asphalt Roller (All); Bobcat-type and/or Skid Steer Loader with or without Attachments; Boiler (15 lbs. pressure & over); All Concrete Pumps without Booms & with 5" System; Forklift (Except Masonry); Highway Drills-All Types (with Integral Power); Hoist (One Drum); House Elevator (except those automatic call button controlled); Man Lift; Material Hoist/Elevator; Mud Jack; Pressure Grouting; Pump (Installing or Operating Well Points or other Type of Dewatering Systems); Pump (4" and over Discharge); Railroad Tie Inserter/Remover; Rotovator (Lime soil Stabilizer); Submersible Pump (4" and over Discharge); Switch & Tie Tamper (w/o lifting & aligning device); Trench Machine (24" & under); & Utility:

BUILDING	BASE RATE	\$25.63
	FRINGE BENEFITS	8.80

Ballast Relocator; Backfiller & Tamper; Batch Plant; Bar & Joint Installing Machine; Bull Floats; Burlap & Curing Machines; Clefplanes; Compressor on Building Construction; Concrete Mixer, Capacity more than one bag; Concrete Mixer, one bag capacity (side loader); All Concrete Pumps without Booms with 4" or Smaller System; Concrete Spreading Machine; Conveyor, used for handling building materials; Crusher; Deckhand; Drum Fireman in Asphalt Plant; Farm Type Tractor, Pulling Attachments; Finishing Machines; Form Trencher; Generator; Gunit Machine; Hydro-Seeder; Pavement Breaker (Hydraulic or Cable); Post Driver; Post Hole Digger; Pressure Pump (over 1/2" discharge); Road Widening Trencher; Roller (except Asphalt); Self-propelled Power Spreader; Self-propelled Sub-Grader; Shotcrete Machine; Tire Repairman; Tractor (Pulling Sheep Foot Roller or Grader); VAC/ALL; Vibratory Compactor (with Integral Power) & Welder:

BUILDING	BASE RATE	\$24.45
	FRINGE BENEFITS	8.80

Allen Screed Paver (concrete); Boiler (less than 15 lbs. Pressure); Directional Drill "Locator"; Masonry Fork Lift; Inboard & Outboard Motor Boat Launch; Light Plant; Oiler; Power Driven Heater (Oil Fired); Power Scrubber; Power Sweeper; Pump (Under 4" discharge); Signal Person; & Submersible Pump (Under 4" discharge):

BUILDING	BASE RATE	\$18.99
	FRINGE BENEFITS	8.80

OPERATING ENGINEERS/HEAVY HIGHWAY

Master Mechanic:	HEAVY & HIGHWAY	BASE RATE	\$27.04
		FRINGE BENEFITS	8.80

CAMPBELL & PENDLETON COUNTIES:

OPERATING ENGINEERS/HEAVY HIGHWAY: (Continued):

Air Compressor on Steel Erection; Barrier Moving Machine; Boiler Operator on Compressor or Generator when mounted on a Rig; Cableway; Combination Concrete Mixer & Tower; Concrete Plant (over 4 yd. Cap.); Concrete Pump; Crane (Including Boom Truck, Cherry Picker); Derrick; Dragline; Dredge (Dipper, Clam or Suction); Elevating Grader or Euclid Loader; Floating Equipment; Gradeall; Helicopter Crew (Operator- Hoist or Winch); Hoe; Hoisting Engine on Shaft or Tunnel Work; Horizontal Directional Drill(over 500,000 ft. lbs. thrust) Industrial-Type Tractor; Jet Engine Dryer (D8 or D9) DieselTractor; Locomotive (Standard Gauge); Maintenance Operator Class A; Mixer, Paving (Single or Double Drum); Mucking Machine; Multiple Scraper; Piledriving Machine; Power Shovel; Prentice Loader; Quad 9 (Double Pusher); Refrigerating Machine (Freezer Operation); Side-Boom; Slip-Form Paver; Tower Derrick; Tree Shredder; Trench Machine (Over 24" wide); Truck Mounted Concrete Pump; Tug Boat; Tunnel Machine and/or Mining Machine; Wheel Excavator; Hydraulic Gantry (Lifting System); Rail Tamper (w/Auto Lifting & Alignment Device); Rough Terrain Fork Lift with Winch/Hoist:

HEAVY & HIGHWAY	BASE RATE	\$26.79
	FRINGE BENEFITS	8.80

Asphalt Paver; Automatic Subgrader Machine, Self-Propelled (CMI Type); Bobcat Type and/or Skid Steer Loader with Hoe Attachment Greater than 7,000 lbs.; Boring Machine More than 48"; Bulldozer; Endloader; Kolman-type Loader (production type-Dirt); Lead Greaseman; Power Grader; Power Scraper; Push Cat; Trench Machine (24" wide & under); Concrete Grinder/Planer; Pettibone-Rail Equipment; Vermeer type Concrete Saw; Hydro Milling Machine; Lighting & Traffic Signal Installation Equipment; Material Transfer Equipment (shuttle buggy) Asphalt:

HEAVY & HIGHWAY	BASE RATE	\$26.67
	FRINGE BENEFITS	8.80

A-Frame; Air Compressor on Tunnel Work (low pressure); Asphalt Plant Engineer; Locomotive (narrow gauge); Mixer, Concrete (more than one bag cap.); Mixer, one bag cap. (Side Loader); Power Boiler, 15 lb. Pressure & Over; Pump Operator installing & operating Well Points; Pump (4" & over discharge); Roller - Asphalt; Utility Operator (Small equipment); Welding Machine; Bobcat Type and/or Skid Steer Loader with or without Attachments; Switch and Tie Tamper (w/o Lifting & Aligning Device); Highway Drills; Railroad Tie Inserter/Remover; & Rotovator (Lime-Soil Stabilizer):

HEAVY & HIGHWAY	BASE RATE	\$25.63
	FRINGE BENEFITS	8.80

CAMPBELL & PENDLETON COUNTIES:

OPERATING ENGINEERS/HEAVY HIGHWAY (Continued):

Backfiller; Ballast Re-locator; Bars, Joint & Mesh Installing Machine; Batch Plant; Boring Machine Operator (48" or less); Bull Floats; Burlap & Curing Machine; Concrete Plant (capacity 4 yd. & under); Concrete Saw (Multiple); Conveyor (Highway); Crusher; Deckhand; Farm-type Tractor with attachments (highway) except Masonry); Finishing Machine; Fireperson, Floating Equipment (all types); Fork Lift (highway); Form Trencher; Hydro Hammer; Hydro Seeder; Pavement Breaker; Plant Mixer; Post Driver; Post Hole Digger (Power Auger); Power Brush Burner; Power Form Handling Equipment; Road Widening Trencher; Roller (Brick, Grade & Macadam); Self-Propelled Power Spreader; Self-Propelled Power Subgrader; Steam Fireperson; Tractor (Pulling Sheepfoot, Roller or Grader); & Vibratory Compactor with Integral Power:

HEAVY & HIGHWAY	BASE RATE	\$24.45
	FRINGE BENEFITS	8.80

Compressor (Portable, Sewer, Heavy & Highway); Drum Fireperson (Asphalt); Generator; Inboard-Outboard Motor Boat Launch; Masonry Fork Lift; Oil Heater (asphalt plant); Oiler; Power Driven Heater; Power Sweeper & Scrubber; Pump (under 4" discharge); Signalperson; Tire Repairperson; & VAC/ALLS

HEAVY & HIGHWAY	BASE RATE	\$18.99
	FRINGE BENEFITS	8.80

CAMPBELL & PENDLETON COUNTIES:

PAINTERS:

Brush; Roller; Paperhanging & Drywall Taping:	BUILDING	BASE RATE	\$22.15
		FRINGE BENEFITS	5.80
Spray:	BUILDING	BASE RATE	\$22.65
		FRINGE BENEFITS	5.80
Sandblasting; Waterblasting:	BUILDING	BASE RATE	\$22.90
		FRINGE BENEFITS	5.80
Lead Abatement:	BUILDING	BASE RATE	\$23.15
		FRINGE BENEFITS	5.80
Sign Painter & Erector:	BUILDING	BASE RATE	\$17.57
		FRINGE BENEFITS	4.55
Elevated Tanks:	HEAVY & HIGHWAY	BASE RATE	\$22.30
		FRINGE BENEFITS	5.90

CAMPBELL & PENDLETON COUNTIES:

PAINTERS (Continued):

BRIDGES – GUARDRAILS – LIGHTPOLES – STRIPING:

Bridge/Equipment Tender and/or Containment Builder:

HEAVY & HIGHWAY	BASE RATE	\$19.68
	FRINGE BENEFITS	5.80

Brush & Roller:	HEAVY & HIGHWAY	BASE RATE	\$22.15
		FRINGE BENEFITS	5.80

Spray:	HEAVY & HIGHWAY	BASE RATE	\$22.65
		FRINGE BENEFITS	5.80

Sandblasting; Waterblasting:	HEAVY & HIGHWAY	BASE RATE	\$22.90
		FRINGE BENEFITS	5.80

Elevated Tanks; Steeplejack Work; Bridge & Lead Abatement:	HEAVY & HIGHWAY	BASE RATE	\$23.15
		FRINGE BENEFITS	5.80

CAMPBELL & PENDLETON COUNTIES:

PLASTERERS:	BUILDING	BASE RATE	\$20.65
		FRINGE BENEFITS	7.25

CAMPBELL & PENDLETON COUNTIES:

PLUMBERS & PIPEFITTERS:		BASE RATE	\$26.32
		FRINGE BENEFITS	11.72

CAMPBELL & PENDLETON COUNTIES:

ROOFERS (excluding sheetmetal):

Roofers:		BASE RATE	\$24.12
		FRINGE BENEFITS	7.62

Pitch:		BASE RATE	\$25.12
		FRINGE BENEFITS	7.62

CAMPBELL COUNTY:

SHEETMETAL WORKERS (including metal roofs):		BASE RATE	\$24.84
		FRINGE BENEFITS	12.55

PENDLETON COUNTY:

SHEETMETAL WORKERS (including metal roofs):	BASE RATE	\$28.40
	FRINGE BENEFITS	11.52

CAMPBELL & PENDLETON COUNTIES:

SPRINKLER FITTERS:	BASE RATE	\$26.05
	FRINGE BENEFITS	11.65

CAMPBELL & PENDLETON COUNTIES:

TRUCK DRIVERS:

3 Tons & Under; Greaser; Tire Changer; & Mechanic Tender: BUILDING	BASE RATE	\$17.52
	FRINGE BENEFITS	8.04

Over 3 Tons; Semi-Trailer or Pole Trailer; Dump Tandem Axles; Farm Tractor (When used to pull building material & equipment):

BUILDING	BASE RATE	\$17.63
	FRINGE BENEFITS	8.04

Concrete Mixer (Hauling on jobsites); & Truck Mechanic:

BUILDING	BASE RATE	\$17.70
	FRINGE BENEFITS	8.04

Euclid's & Other Heavy Moving Equipment; Lowboy; Winch, A-Frame & Monorail Truck (To transport building materials):

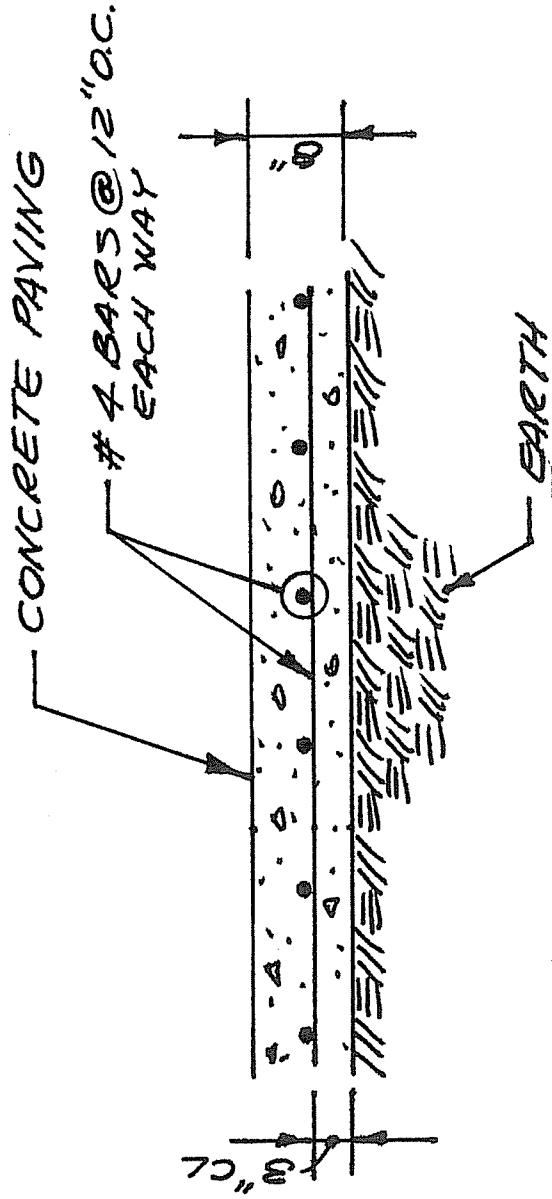
BUILDING	BASE RATE	\$17.80
	FRINGE BENEFITS	8.04

(On hazardous or toxic waste sites, add \$4.00 premium to all of above)

Driver:	HEAVY & HIGHWAY	BASE RATE	\$15.85
		FRINGE BENEFITS	4.60

Euclid Wagon; End Dump; Lowboy; Heavy Duty Equipment; Tractor-Trailer Combination; & Drag:

HEAVY & HIGHWAY	BASE RATE	\$16.29
	FRINGE BENEFITS	4.60



SECTION
Scale: 3/4" = 1'-0"

MP TP CONCRETE PAVEMENT DETAIL

ADDENDUM NO. 2

MEMORIAL PARKWAY TREATMENT PLANT IMPROVEMENTS NORTHERN KENTUCKY WATER DISTRICT August 3, 2006

All Bidders on the above titled Project are hereby advised of the following modifications to the Specifications and Drawings on the Project. These modifications will be a part of the resulting Contract.

SPECIFICATIONS

Item No. AD2-1: Supplementary Conditions (Section 00800)

Delete Article SC-5.02 (1.)

Item No. AD2-2: Construction Staking (Section 01055)

Delete Article 1.03 (D)

Item No. AD2-3: Water Filter and Appurtenances (Section 01374B)

Revise Article 1.02 (D) (2) to an effective size of 0.35mm

Revise the second sentence of Article 1.02 (K) as follows:

The sand shall have an effective size of 0.45 mm and a uniformity coefficient of 1.4 or less.

Item No. AD2-4: Concrete Work (Section 03010)

Revise Article 2.05(C)(1) as follows:

1. 4,000 psi 28-day compressive strength; 600 lbs cement per cubic yard minimum; W/C ratio 0.44 max. Fly ash substitute not permitted.

Item No. AD2-5: Polyethylene Storage Tanks (Section 11354)

Revise Article 2.01 to include PlasTanks Industries as an acceptable manufacturer.

Item No. AD2-6: Mechanical Insulation and Heat Tracing (Section 15250)

As a clarification, the Caustic Soda bulk tanks need to include an insulated blanket.

Item No. AD2-7: Variable Speed Drives (Section 16489)

Article 2.01 A., delete and replace with the following:

- A. Raw Water Transfer Pump Drives shall be 18-Pulse, AC Drives equal to Allen-Bradley Powerflex series or Eaton Cutler-Hammer CPX 9000 Series.
- B. Metering Hose Pump Drives shall be Allen-Bradley, Eaton Cutler-Hammer or equal.

Item No. AD2-8: Control Panels (Section 17100)

Insert the attached section 17100.

DRAWINGS

Item No. AD2-9: Site Plan & Yard Piping (Sheet C-1)

As a clarification, the New Asphalt pavement identified on the western part of the site is bituminous pavement.

Item No. AD2-10: Raw Water Transfer Pump Station Plan and Sections (Sheet M-1)

In Section M1.2, change the 18" valve on the suction side of the pump to a butterfly valve.

Add an additional 30" Butterfly Valve on the suction line between Pump No. 1 and Pump No. 2

Item No. AD2-11: Ex Sedimentation Basins No. 1 and 2 Demolition Plan (Sheet M-2)

As a clarification, the abandoned steel spindles from the previous chain and flight assembly are to be removed and disposed of by the contractor.

As a clarification the chemical building masonry exterior will be built on top of existing walls on the east, south and west sides. The walkways should be saw cut flush with these existing walls as applicable.

The demolition of the weir wall and channel along the east side of the existing sedimentation basins has been revised as shown in the detail attached to this Addendum.

Item No. AD2-12: Chemical Building Partial Plans (Sheets M-4 through M-7)

The chemical tank bulk and day tank pad heights shown on these Sheets are correct and supercede the dimensions shown for these pad heights on the structural drawings. The appropriate reinforcing for each pad is still detailed on Sheet S-1.

The location of the sump pits for the Spare area and the Caustic Soda area are revised to be installed a minimum of 5'-0" away from the east wall of the Chemical Building.

Item No. AD2-13: Chemical Building Partial Plan PACL - Actiflo Sand Areas (Sheet M-7)

The stairs and landing between the Chemical Building and the Actiflo Building are changed to concrete as shown in the structural and architectural drawings.

Item No. AD2-14: Filter Building Lower Plan (Sheet M-28)

A revised drawing of the piping associated with the existing blowers is attached. Notes 11 and 17 are revised as follows:

11. Connect to existing air piping by cutting in new 8" 90 Deg Elbow. Install new 8" 90 Deg Elbows Outside the building to create gooseneck as shown. Connect back to existing air piping inside building by cutting in new 8" 90 Deg Elbow.
17. Install new 8" electrically actuated butterfly valve to serve as pressure control valve. Connect valve to SCADA system for remote operations.

Item No. AD2-15: Chemical Building Infill and Foundation Plan (Sheet S-1)

A new detail for the east side and west side foundation wall is attached to this Addendum.

Item No. AD2-16: Chemical Building Wall Sections (Sheet A-7)

Modify Section 10/A-7 to have #5 rebars in block wall spaced at 32" on center. Dowel #5 rebars into existing concrete wall 12" and set in epoxy grout. Holes shall be 1 1/4" in diameter.

Item No. AD2-17: Electrical Site Plan (Sheet E-2)

Underground Conduit Tag No. 27 should be Tag No. 4.

Item No. AD2-18: Raw Water Transfer Station Plan - Power and Control (Sheet E-9)

Underground Conduit Tag No. 27 should be Tag No. 4.

Item No. AD2-19: Existing Sludge Handling Facilities - Modifications for RWTS Pump VFDS (Sheet E-10)

Underground Conduit Tag No. 27 should be Tag No. 26.

Item No. AD2-20: Plant Overall One-Line Diagram - Revised (Sheet E-14)

Add the following general note:

The Raw Water Transfer Pump VFDS are to be provided by the pump manufacturer. The Electrical Contractor shall be responsible for receiving, storage, handling, installation and wiring.

END ADDENDUM NO. 2

Part 1 General

1.01 Scope

Control panels.

1.02 Submittals

- A. The Contractor shall furnish the following items from the System Manufacturer for approval prior to fabrication:
1. Layout drawings of the front of the panel showing mounting dimensions for all instruments and associated hardware.
 2. Assembly drawings shall include:
 - a. Details of panel fabrication including outline dimensions and locations of rear of panel mounted equipment.
 - b. Wiring layout.
 - c. Wiring and tubing interconnection diagrams.
 3. Electrical wiring and termination drawings.
 4. Complete bill of materials describing all panel components, including manufacturer and complete model number for all components.
 5. Catalog cut sheets for all panel components.

1.03 Record Drawings

Submit shop drawings as listed under Article 1.02 above plus operation and maintenance information.

1.04 Delivery, Storage, and Handling

- A. Wrap the completed panel in polyethylene plastic and crate in a wooden shipping crate with sufficient packing to avoid damage in shipment.
- B. Support the base of the shipping crate with the cross members of sufficient strength and clearance to allow movement of the entire crated panel by fork-lift truck.

S P E C I F I C A T I O N S

FOR

NORTHERN KENTUCKY WATER DISTRICT

Memorial Parkway Treatment Plant Improvements

JULY 2006

RON LOVAN, PRESIDENT/CEO

COMMISSIONERS:

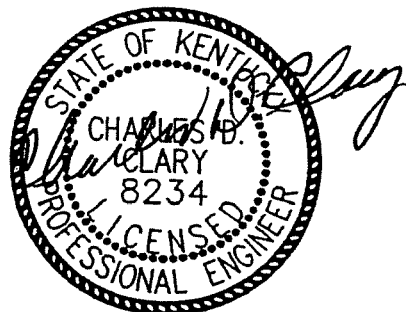
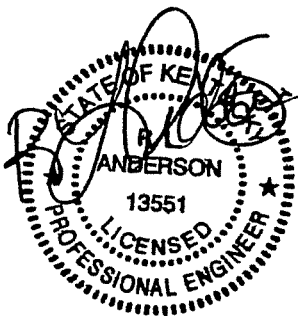
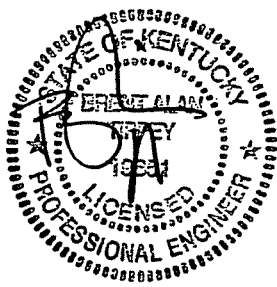
**JOE KOESTER - CHAIRPERSON
ANDREW COLLINS - SECRETARY
FRED MACKE, JR. - TREASURER
PAT SOMMERKAMP - COMMISSIONER
FRANK JACKSON - COMMISSIONER
DOUG WAGNER - COMMISSIONER**

CHARLES PANGBURN - ATTORNEY

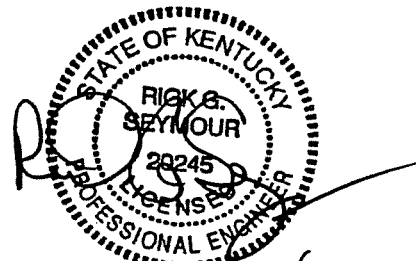
MEMORIAL PARKWAY TREATMENT PLANT IMPROVEMENTS

NORTHERN KENTUCKY WATER DISTRICT

FORT THOMAS, KENTUCKY



4-4-06



4/27/06

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ADDENDUM NO. 1

MEMORIAL PARKWAY TREATMENT PLANT IMPROVEMENTS NORTHERN KENTUCKY WATER DISTRICT July 27, 2006

All Bidders on the above titled Project are hereby advised of the following modifications to the Specifications and Drawings on the Project. These modifications will be a part of the resulting Contract.

SPECIFICATIONS

Item No. AD1-1: Invitation to Bid (Section 00020)

The Bid Date has been changed to August 8, 2006 at 2:00 PM, local time. The bids will be received at the Northern Kentucky Water District Central Facility, 2835 Crescent Springs Road, Erlanger, KY, 41018.

Item No. AD1-2: Instructions to Bidders (Section 00100)

Add Item 23 and 24 as follows:

23. Certain project components may be eligible for exemption from state sales tax. The applicable Kentucky Administrative Regulation (KAR) and Kentucky Revised Statute (KRS) are attached to this Addendum. The Bidder is solely responsible for the determination of any exempt items.
24. The City of Fort Thomas and Campbell County both have payroll and net profits taxes. The Fort Thomas payroll and net profits tax rates are 1.25%. The Campbell County payroll and net profits tax rates are 1.05%.

Item No. AD1-3: Bid Form (Section 00300)

A copy of the Bid Form has been attached to this Addendum for the Bidder's convenience. Please use this form to submit the Bid.

Item No. AD1-4: Supplements to the Bid Form (Section 00400)

A copy of this Section has been attached to this Addendum for the Bidder's convenience. This section must be submitted with the Bid Form.

Item No. AD1-5: Bid Bond (Section 00410)

A copy of this Section has been attached to this Addendum for the Bidder's convenience. This section must be submitted with the Bid Form.

Item No. AD1-6: Statement of Bidder's Qualifications (Section 00420)

A copy of this Section has been attached to this Addendum for the Bidder's convenience. This section must be submitted with the Bid Form.

Item No. AD1-7: Corporate Certificate (Section 00422)

This Section has been deleted.

Item No. AD1-8: Proposed Subcontractors (Section 00423)

Instrumentation and Control has been added to the Subcontractor table. A new Section is attached to this Addendum. This section must be submitted with the Bid Form.

Item No. AD1-9: Contractor's License Certification (Section 00424)

This Section has been deleted.

Item No. AD1-10: Non-Collusion Affidavit (Section 00460)

A copy of this Section has been attached to this Addendum for the Bidder's convenience. This section must be submitted with the Bid Form.

Item No. AD1-11: Agreement (Section 00500)

As a clarification, 10% retainage will be held for the entire duration of the project as identified in this Section.

Item No. AD1-12: Employment Requirements and Wage Rates (Section 00850)

This Project is subject to State Wage Rates. Applicable rates are attached to this Addendum.

Item No. AD1-13: Unique Requirements (Section 01011)

Article 1.06 has been deleted.

Item No. AD1-14: Self-Priming Chemical End Suction Centrifugal Pumps (Section 11230)

Article 2.04, delete the first paragraph and replace with the following:

The pump manufacturer shall furnish a power monitoring system equal to SundGard Power Monitor PM-1000 with display unit PM-2000. The PM-1000 monitor shall operate at 120 VAC with a 10 VDC output to the PM-2000 display unit. The PM-2000 shall include the following:

- a. 3-digit LED Display
- b. Low trip, high trip and start-up delays
- c. Trip range adjustment = 5-100%
- d. Remote reset
- e. 4:20 mA output
- f. NEMA 4X Rating

Item No. AD1-15: Chemical Metering Pumps (Section 11249)

Revise Article 2.01 as follows:

- A. All chemical metering pumps shall be manufactured by Milton Roy (Centrac S pump with B motor and controller).

Revise Article 2.02 (C) as follows:

- C. The pump shall be capable of delivering 1.02 to 100 percent...

Revise Article 2.04 as follows:

1. Centrac S pump motor shall be a 56C frame separately mounted Centrac B motor.

Delete Article 2.04 (2.).

Item No. AD1-16: Water Filter and Appurtenances (Section 11374A)

Article 2.01 is revised to also include Roberts Filter Trilateral Underdrain and General Filter Multiblock Underdrain as Acceptable Manufacturers.

Item No. AD1-17: Fiberglass Storage Tanks (Section 13215)

Revise Article 2.08 (2.) by replacing "right angle helical" with "in line planetary" in the third sentence. Also replace 7/8" with 3/4" in the last sentence.

Item No. AD1-18: PVC, CPVC, Dual Containment Pipe, Flexible Hose and Strainers (Section 15069)

Revise Article 2.02 (F) as follows:

- F. All field welding shall be either butt welded per the general guidelines of ASTM D-2657 for polyolefin piping, and in accordance with the manufacturer's printed guidelines, or joints shall be solvent-cement joints using PVC cement ASTM D-2564. Splitting and re-welding shall not be permitted.

Delete Article 2.03 (H.)

Item No. AD1-19: Valves (Section 15100)

Revise Article 2.01 (C.) (1.) and (2) to also include DeZurik as an Acceptable Manufacturer.

Item No. AD1-20: Pad Mounted Transformers (Section 16325)

Add the following Article:

3.03 Demolition

Contractor shall be completely responsible for removal and disposal of the existing 225 kVA outdoor transformer at the RWTS. Based on records from NKWD, the transformer contains PCBs and therefore, must be disposed of as per EPA Regulations, Title 40, Part 761. Once the transformer has been removed, it must be properly disposed within one year. Contractor must provide written verification of disposal.

Item No. AD1-21: Instrument I/O Listing (Section 17180)

Article 1.01 A.1.b., "LCP-CHEM I/O List", pages 11 and 12 - I/O Reference Nos. 425 - 472 shown as digital inputs, Type "DI" should be digital outputs, Type "DO".

DRAWINGS

Item No. AD1-22: Site Plan & Yard Piping (Sheet C-1)

A detail for the concrete driveway areas has been added and is attached to this Addendum. The concrete thickness has been revised to 8".

Notes 9 and 17 should be revised as follows:

9. Connect 2" PVC SDR 21 Potable Waterline to existing line near front gate as shown on Sheet C-2. Approximate length of pipe between new driveway and the tie-in point shown on C-2 is 185 feet.
17. Connect 6" D.I. Fire Suppression line to existing line near front gate as shown on Sheet C-2. Approximate length of pipe between new driveway and the tie-in point shown on C-2 is 185 feet.

Item No. AD1-23: Chemical Building Sitework Details (Sheet C-2)

The indicator arrow for Note 4 on the Plant Water Connection Plan refers to the wrong location. It should be revised to show the connection point for the potable water system.

Note 6 on the Plant Water Connection Plan should be revised to identify PVC SDR 21 as the appropriate pipe material.

Item No. AD1-24: Chemical Feed Building Overall Plan (Sheet M-3)

The top of slab elevations for the recessed slabs in the Corrosion Control area and the Filter Aid Polymer area are revised to be 759.50'.

Item No. AD1-25: Chemical Building Partial Plan (Sheet M-6)

As a clarification, the Contractor is not responsible for providing any Corrosion Inhibitor or Filter Aid Polymer chemical. Equipment systems shall be provided by the Contractor as shown and specified.

Item No. AD1-26: Chemical Building Copper Sulfate/Sodium Hypochlorite Areas Section (Sheet M-11)

As a clarification, the Contractor is not responsible for providing any Copper Sulfate chemical. Equipment systems shall be provided by the Contractor as shown and specified.

Item No. AD1-27: Filter Underdrain Option No. 1 Plans and Sections (Sheet M-31)

Revise the height shown on Standard Block Underdrain Profile to 13" when the media support cap/plate is included.

Item No. AD1-28: Chemical Building Infill and New Foundation Plan (Sheet S-1)

The Ferric Sulfate/PACL area should be revised in order to show another sump pump area (total of two) as detailed on Drawing M-3.

Item No. AD1-29: Chemical Building New Roof Framing Plan (Sheet S-2)

The New Roof Framing Plan should be revised to show 29 precast concrete panels (4'-0" each).

On Section D, the PAC concrete slab should be revised to 5" in thickness.

Item No. AD1-30: Chemical Building Sections and Details (Sheet S-3)

On Section B, the concrete slab outside the building should be revised to 8" in thickness as shown on other sections.

The note on Section C should be revised to indicate an 8" thick CMU wall.

On Section E, the concrete floor slab should be revised to 6" thick as shown elsewhere in the Drawings.

On Section H, the wall height should be revised to 8' as shown elsewhere on the Drawings.

Item No. AD1-31: Chemical Building Notes and Details (Sheet S-5)

On Section B, the waterstop shown should be a "dumbbell" type and meet the following specification:

Waterstop: PVC, minimum 1,750 PSI tensile strength, -51 degrees F to +175 degrees F working temperature range; flat profile; corrugated flaps, large split center bulb; size as noted on the Drawings (or 6 inches if not shown).

Item No. AD1-32: Existing Sludge Handling Facilities – Modifications for RWTS Pump VFDs (Sheet E-10)

Add a 600 amp, 480 volt, fusible disconnect switch in NEMA 4X enclosure for the feeder from the pad mount transformer to the transfer switch. Fuse at 450 amp. Switch to be exterior wall mounted at the point where the feeder enters the building.

Item No. AD1-33: Plant Overall One-Line Diagram Revised (Sheet E-14)

Delete the 1,000-amp breaker shown on the primary side of the new 300 kVA transformer. Specification Section 16325 requires a 200-amp switch on the transformer primary.

Item No. AD1-34: Plant Overall One-Line Diagram Revised (Sheet E-14)

Add the following notes:

General Notes:

1. The existing 480-volt switchgear in the MPTP Electrical Building is General Electric Spectra Series.
2. The existing 480-volt switchgear in the RWTS Electrical Building is Eaton Cutler-Hammer.

Item No. AD1-35: Plant Overall One-Line Diagram Revised (Sheet E-14)

The One-Line Diagram should have a 600 amp, 480 volt, fusible disconnect switch on the secondary feeder of the 300 kVA transformer between the transformer and transfer switch. Fuse at 450 amp.

Item No. AD1-36: Control Schematics (Sheet E-15)

The power monitor shown for the Transfer Pump Control Schematic is specified in Section 11230, Article 2.04. As specified, it is equal to a "SundGard Power Monitor PM-2000". The monitor is DIN Rail mounted, 2.76" x 3.38" x 2.28". The display is panel mounted, 2.83" x 2.83" x 2.7". The Electrical Contractor is to verify actual unit and dimensions with the supplier.

Item No. AD1-37: Miscellaneous Details and Underground Conduit and Wire Schedule (Sheet E-17)

Change Tag Note 3 to: 2 - 3" conduits, each with 4-#4/0, 1-#2 Ground.

END OF ADDENDUM NO. 1

103 KAR 30:120. Machinery for new and expanded industry.

RELATES TO: KRS 139.170, 139.480

STATUTORY AUTHORITY: KRS Chapter 13A

NECESSITY, FUNCTION, AND CONFORMITY: To interpret the sales and use tax law as it applies to exemption qualification for "machinery for new and expanded industry."

Section 1. Requirements for Exemption. The machinery and the appurtenant equipment necessary to the completed installation of such machinery, together with the materials directly used in the installation of such machinery and appurtenant equipment, which are incorporated for the first time into new or existing plant facilities, or which are installed in the place of existing plant machinery having a lesser productive capacity, and which are directly used in a manufacturing or processing production operation shall be exempt from the sales and use tax. The term "processing production" shall include: the processing and packaging of raw materials, in-process materials, and finished products; the processing and packaging of farm and dairy products for sale; and the extraction of minerals, ores, coal, clay, stone and natural gas. In summary, the following four (4) specific requirements must be met before machinery qualifies for exemption:

- (1) It must be machinery.
- (2) It must be used directly in the manufacturing process.
- (3) It must be incorporated for the first time into plant facilities established in this state.
- (4) It must not replace other machinery.

Section 2. Analysis of Requirements. (1) It must be machinery. The term "machinery" shall mean: machines, in general, or collectively; also, the working parts of a machine, engine, or instrument; as, the machinery of a watch. (Webster's New International Dictionary). This definition does not specify that machinery must have working parts and be able to perform a function in and of itself, as a "machine" would. The machinery of a manufacturing operation is composed of all the components making up the process, including the fixed and nonmoving parts as well as the moving parts. This is illustrated in the example of the machinery of a watch.

(2) It must be used directly in the manufacturing process. Machinery must be intimately involved in production in order to be considered used "directly" in the manufacturing process. The fact that machinery is necessary for a manufacturing process does not automatically qualify it for exemption. A single manufacturer may, within his primary manufacturing process, have more than one (1) production activity.

(a) Primary manufacturing process.

1. The primary manufacturing process is the production operation resulting in a finished product which will be transferred from the producing plant for distribution to customers or for further processing at another plant site. Production begins at a point where the raw material enters a process and is acted upon to change its size, shape, or composition or is transformed in some manner. Production ends when the finished goods are packaged or ready for sale. Packaging is considered complete when the product is in the container in which it is normally received by the purchaser.

2. All activities preceding the point of introduction of the raw material into the manufacturing process and following the point at which the finished product is packaged or ready for sale are not production activities and the machinery used therein is subject to tax.

3. Storage facilities, including those provided for the storage of in-process materials which have been removed from the production line to await further processing, are not used directly in the manufacturing process and are subject to tax. Proximity of storage facilities to the production line is immaterial.

(b) Contributory or secondary manufacturing process. This activity generally falls into one (1) of four (4) categories:

1. The manufacture of industrial tools to be used in the manufacturing process. Examples include the manufacture of dies, patterns, rolls, molds, cutters and cutter blades, and like property. The exemption for machinery used herein is determined by the same criteria used for determining the exemption provided in the primary manufacturing process.

2. The processing of materials which do not become an ingredient of the finished product but are consumed as industrial supplies directly in the primary manufacturing process. Examples include water cooling systems, bottle washing preparatory to filling, and chemical processes whereby the chemical is used as a catalyst directly on the product being manufactured. This machinery exemption begins at the point where the material is acted upon to condition it for use in the manufacturing process or at the point where it performs a function itself, if it is not acted upon prior to that point. The exemption ends when the material leaves the process.

3. Electrical machinery and similar equipment used directly in the operation of other machinery which is used directly in the manufacturing process.

4. Machinery used exclusively for quality control of in-process material or the efficient operation of machinery. Examples are air cooling or

air conditioning systems, control panels, exhaust systems, and similar activities.

(3) It must be incorporated for the first time into plant facilities established in this state. To meet this requirement, the machinery must be installed in this state for the first time and it must be incorporated into plant facilities in this state. Machinery which has been once installed into manufacturing facilities in this state may be subject to tax as provided in 103 KAR 30:200 when subsequently sold by that manufacturer. Machinery purchased and delivered in Kentucky is subject to tax when the machinery is not acquired for installation in Kentucky.

(4) It must not replace other machinery. New machinery purchased to replace other machinery in the plant is subject to tax unless the new machinery performs a different function, manufactures a different product, or has a greater productive capacity, measured by units of production, than the machinery replaced. Modification of machinery to perform a different function or manufacture a different product qualifies for exemption.

Section 3. In all cases where a question arises concerning the exemption of machinery for new and expanded industry, the burden of proof that each qualification has been met is upon the one seeking the exemption. (SU-6-1; 1 Ky.R. 469; eff. 3-12-75.)

139.170 Definitions.

- (1) "Machinery for new and expanded industry" means machinery:
 - (a) Used directly in a manufacturing or processing production process;
 - (b) Which is incorporated for the first time into a plant facility established in this state; and
 - (c) Which does not replace machinery in the plant facility unless that machinery purchased to replace existing machinery:
 1. Increases the consumption of recycled materials at the plant facility by not less than ten percent (10%);
 2. Performs different functions;
 3. Is used to manufacture a different product; or
 4. Has a greater productive capacity, as measured in units of production, than the machinery being replaced.

The term "machinery for new and expanded industry" does not include repair, replacement, or spare parts of any kind regardless of whether the purchase of repair, replacement, or spare parts is required by the manufacturer or vendor as a condition of sale or as a condition of warranty. The term "processing production" shall include the processing and packaging of raw materials, in-process materials, and finished products; the processing and packaging of farm and dairy products for sale; and the extraction of minerals, ores, coal, clay, stone, and natural gas.

- (2) "Manufacturing" for the purposes of this section only means any process through which material having little or no commercial value for its intended use before processing has appreciable commercial value for its intended use after processing by the machinery. The manufacturing or processing production process commences with the movement of raw materials from storage into a continuous, unbroken, integrated process and ends when the product being manufactured is packaged and ready for sale.
- (3) "Plant facility" means a single location that is exclusively dedicated to manufacturing or processing production activities. For purposes of this section, a location shall be deemed to be exclusively dedicated to manufacturing activities even if retail sales are made there, provided that the retail sales are incidental to the manufacturing activities occurring at the location. The term "plant facility" shall not include any restaurant, grocery store, shopping center, or other retail establishment.
- (4) "Repair, replacement, or spare parts" means any tangible personal property used to maintain, restore, mend, or repair machinery or equipment. "Repair, replacement, or spare parts" does not include machine oils, grease, or industrial tools.
- (5) "Recycled materials" means materials which have been recovered or diverted from the solid waste stream and reused or returned to use in the form of raw materials or products.

Effective: March 15, 2001

History: Amended 2001 Ky. Acts ch. 68, sec. 1, effective March 15, 2001. -- Amended 1994 Ky. Acts ch. 501, sec. 1, effective July 15, 1994. -- Amended 1991 (1st Extra.

Section 00300

BID FORM

PROJECT IDENTIFICATION:

Memorial Parkway Treatment Plant Improvements

THIS BID IS SUBMITTED TO:

Northern Kentucky Water District
2835 Crescent Springs Road
Erlanger, Kentucky 41018

1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Contract Documents to perform all Work as specified or indicated in the Contract Documents within the time indicated and for the amount indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

2. Bidder accepts all of the terms and conditions of the Invitation to Bid and the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 90 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner. Bidder understands that certain extensions to the time for acceptance of this Bid may require the consent of the surety for the Bid Bond.

3. In submitting this Bid, Bidder represents and covenants, as set forth in the Agreement, that:

a. Bidder has examined and carefully studied the Contract Documents, the other related data identified in the Contract Documents, and the following Addenda, receipt of all of which is hereby acknowledged:

No. _____ Dated _____

No. _____ Dated _____

No. _____ Dated _____

No. _____ Dated _____

No. _____ Dated _____

No. _____ Dated _____

b. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

- c. Bidder is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.
 - d. Bidder has obtained and carefully studied (or assumes responsibility for having done so) all additional or supplementary explorations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents to be employed by Bidder, and safety precautions and programs incident thereto.
 - e. Bidder does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Contract Documents.
 - f. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
 - g. Bidder has correlated the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.
 - h. Bidder has given Owner written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Contract Documents, and the written resolution thereof by Owner is acceptable to Bidder.
 - i. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.
4. Bidder further represents that this Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization, or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any individual or entity to refrain from bidding; and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over Owner.

5. Bidder will complete the Work for the following price:

*** BASE BID ***

ITEM 1 – Furnishing all products, materials and equipment and performing all labor necessary to complete and put into operation the Memorial Parkway Treatment Plant Improvements, including all work shown on the Drawings and/or specified and not included in Item 2 below, nor the Alternate the amount of: \$ _____ (in numbers) and _____ DOLLARS (in words).

ITEM 2 - CONCRETE RESTORATION

- | | | | | | |
|----|-------|--------|------------------------------|-------------|----------|
| a. | 800 | SQ.FT. | Interior Vertical Surfaces | \$ _____/SF | \$ _____ |
| b. | 600 | SQ.FT. | Exterior Vertical Surfaces | \$ _____/SF | \$ _____ |
| c. | 1,800 | SQ.FT. | Underside of Beams and Slabs | \$ _____/SF | \$ _____ |

BASE BID TOTAL, ITEMS 1 THROUGH 2, INCLUSIVE, THE AMOUNT OF \$ _____ (in numbers) and _____ DOLLARS (in words).

*** ALTERNATE BID ***

Add, for constructing the powdered activated carbon feed system housed in a pre-engineered metal building as shown on the Drawings and as specified, the Lump Sum Amount of \$ _____ (in numbers) and _____ DOLLARS (in words).

6. Bidder agrees that the Work will be substantially complete within 330 calendar days, and completed and ready for final payment in accordance with paragraph 14.07.B of the General Conditions within 360 calendar days, after the date when the Contract Times commence to run as defined in the General Conditions.

7. Communications concerning this Bid shall be sent to Bidder at the following address:

8. The terms used in this Bid, which are defined in the General Conditions included as part of the Contract Documents, have the meanings assigned to them in the General Conditions.

9. The Bidder shall designate below the one manufacturer for each product to be furnished and installed if awarded the Work. The Bidder understands that if this information is not provided or Bidder does not offer products meeting all Specification requirements and having the approval of the Engineer, then the Owner reserves the right either to determine the Bidder non-responsive and reject the Bid or to designate the manufacturer of the products to be provided which will meet all specification requirements, which Owner-designated manufacturer products must be furnished by the Bidder at no increase in the Contract Price.

SIGNATURE OF BIDDER

If an Individual

Name (typed or printed): _____

By _____ (SEAL)
(Individual's signature)

doing business as _____

Business address _____

Phone No.: _____ Fax No.: _____

Date _____

If a Partnership

Partnership Name: _____ (SEAL)

By _____
(Signature of general partner - attach evidence of authority to sign)

Name (typed or printed): _____

Business address _____

Phone No. _____ Fax No.: _____

Date _____

If a Corporation

Corporation Name: _____ (SEAL)

State of Incorporation: _____

Type (General, Professional, Service, Limited Liability): _____

By _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

(CORPORATE SEAL)

Attest _____

Business address _____

Phone No. _____ Fax No.: _____

Date _____

If a Joint Venture

(Each joint venturer must sign. The manner for signing for each individual, partnership, and corporation that is party to the joint venture should be in the manner indicated above.)

Joint Venturer Name: _____ (SEAL)

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

Phone No.: _____ Fax No.: _____

Joint Venturer Name: _____ (SEAL)

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

Phone No.: _____ Fax No.: _____

Date _____

Section 00400

SUPPLEMENT TO BID FORM

1. FORMS TO BE SUBMITTED WITH BID. A portion of the funding for this project comes from a Drinking Water State Revolving Fund (DWSRF) loan. This loan originates with the United States Environmental Protection (USEPA) and has several provisions that directly impact the Bidder. The items identified in Item 1 of this section must be submitted with the Bid. These include:

- a. A certification that the Bidder, and any subcontractors used by the Bidder, are not on the Federal List of Debarred Contractors. Attachment No. 1 (CERTIFICATION REGARDING DEBARMENT, SUSPENSION AND OTHER MATTERS – EPA Form 5700-49) in Section 00400 addresses this item and must be executed and included with the Bid.
- b. A certification by the Bidder that no appropriated funds were or will be used for the purposes of lobbying the legislative or executive branches of the Federal government. Attachment No. 2 (CERTIFICATION REGARDING LOBBYING) in Section 00400 addresses this item and must be submitted with the Bid.
- c. A requirement to utilize minority or women owned businesses as subcontractors where possible. Bidders are required to make positive efforts towards this end and document the steps taken to encourage their participation. Attachment No. 3 (MBE/WBE DATA SHEET I) in Section 00400 addresses this item and must be filled out and submitted with the Bid.

2. FORMS TO BE SUBMITTED BY APPARENT LOW BIDDER AFTER BID OPENING. The DWSRF loan creates additional documentation requirements on both the Contractor and the Owner. These are set forth in the Supplemental General Conditions for Drinking Water State Revolving Fund Loans (DWSRF Supplemental General Conditions). The remaining items identified in the DWSRF Supplemental General Conditions Section will be submitted by the apparent low bidder within 21 days of the Bid opening. The project will not be awarded until this information is received.

CERTIFICATIONS

Debarred Firms

All prime Construction Contractors shall certify that Subcontractors have not and will not be awarded to any firm that is currently on the EPA Master List of Debarred, Suspended and Voluntarily Excluded Persons in accordance with the provisions of 40 CFR 32.500(c). Debarment action is taken against a firm for noncompliance with Federal Law.

All bidders shall complete the attached certification (Attachment Number 10) and submit to the owner with the bid proposal.

Anti-lobbying Certification

All prime Construction Contractors must certify (Attachment Number 11) that no appropriated funds were or will be expended for the purpose of lobbying the Executive or Legislative Branches of the Federal Government or Federal Agency concerning this contract (contract in excess of \$100,000). If the Contractor has made or agreed to make payment to influence any member of Congress in regard to award of this contract, a Disclosure Form must be completed and submitted to the owner with the bid proposal.

All prime Contractors must require all Subcontractors to submit the certification, which must also be submitted to the owner.

**CERTIFICATION REGARDING DEBARMENT,
SUSPENSION AND OTHER RESPONSIBILITY MATTERS**

The prospective participant certifies to the best of its knowledge and belief that it and its principals:

(A) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(b) Have not within a three year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. In addition, under 18 USC Sec. 1001, a false statement may result in a fine of up to \$10,000 or imprisonment for up to 5 years, or both.

Typed Name & Title of Authorized Representative

Signature of Authorized Representative

Date

_____ I am unable to certify to the above statements. My explanation is attached.

CERTIFICATION REGARDING LOBBYING
Certification for Contracts, Grants,
Loans, and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

TYPED NAME & TITLE OF AUTHORIZED REPRESENTATIVE

SIGNATURE OF AUTHORIZED REPRESENTATIVE DATE

_____ I am unable to certify to the above statements. My explanation is attached.

UTILIZATION OF SMALL, MINORITY AND WOMEN'S BUSINESSES

The provisions of PL 102-389 and EPA's implementing regulation 40 CFR 31.36(e) require recipients of Federal assistance to award a fair share of sub-agreements to small, small rural, minority and women's businesses on contracts and sub-agreement performed under EPA Assistance Agreements.

The following procedures are to be followed for procurement under EPA Assistance Agreements.

The successful bidder must submit to the grantee within 10 days after bid opening, evidence of the positive steps taken to utilize small, minority and women's businesses. Information should include the following:

EPA Project Number. Project Location. Type of Construction.

List of current construction contracts, with dollar amount. List contracting Federal Agency, if applicable.

List of subcontractors (name, address and telephone) with dollar amount and duration of subcontract.

List of any subcontract work yet to be committed with estimate of dollar amount and duration of contract.

Contract Price. Duration of prime contract.

Such positive efforts shall include:

- (1) Placing qualified small and minority businesses and women's business enterprises on solicitation lists;
- (2) Assuring that small and minority businesses, and women's business enterprises are solicited whenever they are potential sources;
- (3) Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority business, and women's business enterprises;
- (4) Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority business, and women's business enterprises;
- (5) Using the services and assistance of the Small Business Administration, and the Minority Business Development Agency of the Department of Commerce; and
- (6) Requiring each party to a sub-agreement to take the affirmative steps listed in paragraphs 1 through 5 of this section.

For purposes of clarification:

" This requirement applies to any EPA Financially assisted procurement.

" This requirement mandates three responsibilities. Separate solicitations must be made of small, small rural, minority and women's businesses enterprises.

" A minority business is a business, at least 51 percent of which is owned and controlled by minority group members (Black; Hispanic; Asian American; American Indian; and any other designations approved by the Office of Management and Budget that are U.S. citizens. Any specific clarification concerning the ownership and/or control issues will be provided by the EPA Regional Office.

" A women's business is a business, at least 51 percent of which is owned and controlled by one or more women who are U.S. citizens.

" The control determination will revolve around the minority or women owner's involvement in the day-to-day management of the business enterprise.

" Solicitation should allow adequate time for price analysis; EPA recommends that contact be made no later than 15 days before bid opening.

" Efforts taken to comply with this requirement must be documented in detail; maintain records of firms contacted, including any negotiation efforts to reach competitive price levels, and awards to the designated firms.

" Any proposed changes from the approved Minority/Women/Small business participation after EEO/MBE approval shall be reported to EPA prior to initiation of the action, with the reason for the proposed deviation.

" The EPA recommends that the grantee as well as the prime contractor utilize the services of the following agencies to find information on certified Minority/Women/Small business. Use of these services does not absolve the prime contractors from pursuing additional efforts to comply with this requirement.

Minority Business Development Service Centers These Centers are funded by the U.S. Department of Commerce to provide technical, financial and contracting assistance to minority, women's and small rural business enterprises. The locations of the Centers are available by selecting the appropriate Minority Business Development Agency regional office from: <http://www.mbda.gov/>.

U.S. Small Business Administration Central Contractor Registration (procurement marketing and access network) at <http://www.ccr.gov/>.

U.S. Small Business Administration (SBA) Online Women's Business Center. For the Women's Business Center nearest you, go to: <http://www.onlinewbc.gov/> and select Women's Business Centers.

For additional information on listings of certified MBE/WBE contractors and subcontractors in the States of Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee, contact Rafael Santamaria in EPA Region 4 at 404 562-8312.

MINORITY AND WOMEN'S BUSINESS ENTERPRISE PARTICIPATION POLICY

MBE/WBE DATA SHEET I

PROJECT NAME: _____ BID DATE: _____

1. Name, address and telephone number of contact person on all MBE, WBE matters.

Contractor's Name: _____

Address: _____

Telephone Number: _____

2. Has the bidder met at least the minimum 3% and 5% goals?

Yes (submit MBE/WBE DATA SHEET II, including certifications and subcontracts (or letters of intent signed by both parties, identifying the type of work and the dollar amount) within 21 days)

No (submit MBE/WBE DATA SHEET III, including all documentation to support a good faith effort within 21 days)

If no, please provide an explanation of the bidders inability to achieve the required goals and list any uncommitted areas of work.

End of Section

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS, that we, _____, as Principal, and _____, as Surety, are held and firmly bound unto the Northern Kentucky Water District in the sum of _____ Dollars (\$ _____) lawful money of the United States of America, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, personal representatives, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted to the Owner a Bid for construction of Memorial Parkway Treatment Plant Improvements.

NOW THEREFORE, the conditions of this obligation are such that if the Bid be accepted, the Principal shall, within ten days after receipt of conformed Contract Documents, execute a Contract in accordance with the Bid upon the terms, conditions and prices set forth therein, and in the form and manner required by the Contract Documents and execute sufficient and satisfactory separate Performance and Payment Bonds payable to the Owner, each in an amount of 100 percent of the total Contract Price, in form satisfactory to the Owner, then this obligation shall be void; otherwise, it shall be and remain in full force and effect in law; and the Surety shall, upon failure of the Principal to comply with any or all of the foregoing requirements within the time specified above, immediately pay to the aforesaid Owner, upon demand, the amount hereof in good and lawful money of the United States of America, not as a penalty, but as liquidated damages.

IN WITNESS WHEREOF, the said Principal has hereunder affixed its signature and seal, and said Surety has hereunto caused to be affixed its corporate signature and seal, by its duly authorized officers, on this _____ day of _____, 200_____.

CONTRACTOR – PRINCIPAL:

By: _____
(name signed)

(name printed or typed)

Title: _____

Address: _____

Attest: _____
(name signed)

(name printed or typed)

Title: _____ (SEAL)

Note: Attest for a corporation must be by the corporate secretary; for a partnership by another partner; for an individual by a notary.

SURETY:

By: _____
(name signed)

(name printed or typed)

Title: _____

Address: _____

Attest: _____
(name signed)

(name printed or typed)

Title: _____ (SEAL)

Note: Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the Project is located.

END OF SECTION

Statement of Bidder's Qualifications

All questions must be answered and the data given must be clear and comprehensive. This statement must be notarized. If necessary, questions may be answered on separate attached sheets. The Bidder may submit any additional information desired. Attach all additional sheets to this statement. (Sample "Project Information Form" contained at the end of this Section.)

1. Name of Bidder: _____
2. Permanent main office address and phone number: _____

3. When organized: _____
4. If a Corporation, where incorporated: _____
5. How many years have you been engaged in the contracting business under your present firm or trade name? _____
6. Contracts on hand. (Complete a "Project Information Form", for each Contract on hand.)
7. General description of type of work performed by your company: _____

8. Have you ever failed to complete any work awarded to you? If so, where and why? _____

9. Have you ever defaulted on a contract? If so, where and why? _____

10. Attach a list of the most important projects recently completed by your company which are similar in scope to this Project. (Complete a "Project Information Form", for each Project listed.)
11. Names, background and experience of the principal members of your organization, including officers:

Name	Position	Years Experience
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Statement of Bidder's Qualifications

12. The undersigned hereby authorizes and requests any person, firm, or corporation to furnish any information requested by the Owner in verification of the recitals comprising this Statement of Bidder's Qualifications.

I, _____, certify that I am _____ of the Bidder, and that the answers to the foregoing questions and statements contained therein are true and correct.

BIDDER: _____

By: _____

(name signed)

(name printed or typed)

Title: _____

Date: _____

Subscribed and sworn to me this ___ day of _____, 200__.

NOTARY PUBLIC: _____

(name signed)

(name printed or typed)

Commission Expires: _____

(Date)

(SEAL)

Project Information Form

Project Title: _____

Project Description: _____

Project Owner:

- Owner Name: _____
- Contact Person: _____
- Phone Number: _____

Engineer/Construction Manager:

- Company Name: _____
- Contact Person: _____
- Phone Number: _____

Contract Amount:

- Initial: _____
- Final: _____

Contract Time

- Initial: _____
- Final: _____
- Completion Date: _____

END OF SECTION

Proposed Subcontractors

The Bidder shall list all subcontractors, providing subcontracting services, in excess of \$50,000 (but is not required to list those only furnishing products or materials), to be utilized in the performance of the work. If the Bidder intends to self-perform the indicated work, the Bidder shall write "Self-Perform" on such line. This list shall be submitted in the following format:

Subcontractor (Name & City, State)	Nature of Work to be Contracted
	Electrical
	Plumbing
	Grading
	Painting
	Heating, Ventilation, Air Conditioning
	Concrete Placement
	Masonry
	Concrete Restoration
	Instrumentation And Control

The Bidder shall designate below the one manufacturer for each product to be furnished and installed if awarded the Work. The Bidder understands that if this information is not provided or Bidder does not offer products meeting all Specification requirements and having the approval of the Engineer, then the Owner reserves the right either to determine the Bidder non-responsive and reject the Bid or to designate the manufacturer of the products to be provided which will meet all specification requirements, which Owner-designated manufacturer products must be furnished by the Bidder at no increase in the Contract Price.

1. Product: Peristaltic Type Hose Pumps
Manufacturer: _____
Model No.: _____

2. Product: Horizontal Split Case Centrifugal Pumps
Manufacturer: _____
Model No.: _____

3. Product: Powdered Activated Carbon Feed System
Manufacturer: _____
Model No.: _____

4. Product: Fiberglass Storage Tanks
Manufacturer: _____
Model No.: _____

5. Product: Water Filter and Appurtenances
Manufacturer: _____
Model No.: _____

NOTE: Any proposed changes from the above list shall be submitted in writing to the Owner prior to initiation of the action, with the reason for the proposed deviation.

END OF SECTION

Section 00460

NON-COLLUSION AFFIDAVIT

STATE OF: _____)

COUNTY OF: _____) SS

_____, being first duly sworn, deposes

and says that he/she is the _____ of
(sole owner, a partner, president, secretary, etc.)

_____, the party making the foregoing bid; that such bid is genuine and not collusive or sham; that said bidder is not financially interested in, or otherwise affiliated in a business way with any other bidder on the same contract; that said bidder has not colluded, conspired, connived, or agreed, directly or indirectly, with any bidder or person, to put in a sham bid, or that such other person shall refrain from bidding, and has not in any manner directly or indirectly sought by agreement or collusion, or communication or conference, with any person, to fix the price or affidavit of any other bidder, or that of any other bidder, or to secure any advantage against Owner, or any person or persons interested in the proposed Contract; and that all statements contained in said bid are true; and further, that such bidder has not, directly or indirectly submitted this bid, or the contents thereof, or divulged information of data relative thereto to any association or to any member or agent thereof.

AFFIANT

Sworn to and subscribed before me, a Notary Public in and for the above named

State and County, this _____ day of _____, 20 _____.

NOTARY PUBLIC

End of Section



Ernie Fletcher
Governor

**ENVIRONMENTAL AND PUBLIC PROTECTION CABINET
DEPARTMENT OF LABOR**

OFFICE OF WORKPLACE STANDARDS
1047 US Hwy 127 S STE 4
Frankfort, Kentucky 40601
Phone: (502) 564-3070
www.labor.ky.gov

LaJuana S. Wilcher
Secretary

Philip J. Anderson
Commissioner

Christopher H. Smith
Executive Director

July 6, 2006

Brent Tippey
Quest Engineers, Inc.
2517 Sir Barton Way
Lexington KY 40509

Re: Northern Kentucky Water District, Memorial Parkway Treatment Plant Improvements

Advertising Date as Shown on Notification: July 13, 2006

Dear Brent Tippey:

This office is in receipt of your written notification on the above project as required by KRS 337.510 (1).

I am enclosing a copy of the current prevailing wage determination number CR-1-024, dated January 25, 2006 for CAMPBELL County. This schedule of wages shall be attached to and made a part of the specifications for the work, printed on the bidding blanks, and made a part of the contract for the construction of the public works between the public authority and the successful bidder or bidders.

The determination number assigned to this project is based upon the advertising date contained in your notification. There may be modifications to this wage determination prior to the advertising date indicated. In addition, if the contract is not awarded within 90 days of this advertising date or if the advertising date is modified, a different set of prevailing rates of wages may be applicable. It will be the responsibility of the public authority to contact this office and verify the correct schedule of the prevailing rates of wages for use on the project. Your project number is as follows:
019-H-00225-06-1, Heavy/Highway

Sincerely,

John Fitzpatrick
Prevailing Wage Specialist

KENTUCKY DEPARTMENT OF LABOR
PREVAILING WAGE DETERMINATION
CURRENT REVISION
LOCALITY 24

CAMPBELL & PENDLETON COUNTIES

Determination No. CR-1-024 2006

Project No. 019-H-00225-06-1 Type: _____ Bldg <u>XXX</u> HH
--

Date of Determination: January 25, 2006

This schedule of the prevailing rate of wages for Campbell & Pendleton Counties has been determined in accordance with the provisions of KRS 337.505 to 337.550. This determination shall be referred to as Prevailing Wage Determination No. CR-1-024 2006.

Apprentices shall be permitted to work as such subject to Administrative Regulations adopted by the Executive Director of Workplace Standards. Copies of these regulations will be furnished upon request to any interested person.

Overtime is to be computed at not less than one and one-half (1 1/2) times the indicated BASE RATE for all hours worked in excess of eight (8) per day, and/or in excess of forty (40) per week. However, KRS 337.540 permits an employee and employer to agree, in writing, that the employee will be compensated at a straight time base rate for hours worked in excess of eight (8) hours in any one calendar day, but not more than ten (10) hours worked in any one calendar day, if such written agreement is prior to the over eight (8) hours in a calendar day actually being worked, or where provided for in a collective bargaining agreement. The fringe benefit rate is to be paid for each hour worked at a straight time rate for all hours worked.

Fringe benefit amounts are applicable for all hours worked except when otherwise noted. Welders will receive rate for craft in which welding is incidental.

NOTE: The type of construction shall be determined by applying the following definitions:

BUILDING CONSTRUCTION

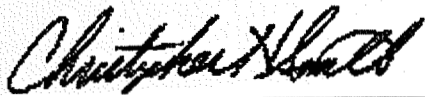
Building construction is the construction of sheltered enclosures with walk-in access for the purpose of housing persons, machinery, equipment, or supplies. It includes all construction of such structures, the installation of utilities and the installation of equipment, both above and below grade level, as well as incidental grading, utilities and paving.

HIGHWAY CONSTRUCTION

Highway construction includes the construction, alteration or repair of roads, streets, highways, runways, taxiways, alleys, trails, paths, parking areas, and other similar projects not incidental to building or heavy construction. It includes all incidental construction in conjunction with the highway construction project.

HEAVY CONSTRUCTION

Heavy projects are those projects that are not properly classified as either "building" or "highway". For example, dredging projects, water and sewer line projects, dams, flood control projects, sewage treatment plants and facilities, and water treatment plants and facilities are considered heavy.



Christopher H. Smith, Executive Director
Office of Workplace Standards
Kentucky Department of Labor

Determination No. CR-1-024 2006
January 25, 2006

CAMPBELL & PENDLETON COUNTIES:

ASBESTOS/INSULATION WORKERS:

Asbestos/Insulation Workers: (Includes application of all insulating materials, protective coverings, coatings & finishing to all types of mechanical systems):

BASE RATE	\$23.18
FRINGE BENEFITS	10.44

Hazardous Material Handler ((Includes preparation, wetting, stripping, removal, scrapping, vacuuming, bagging and disposing of all insulation materials, whether they contain asbestos or not, from mechanical systems):

BASE RATE	\$19.60
FRINGE BENEFITS	7.00

CAMPBELL & PENDLETON COUNTIES:

BOILERMAKERS:

BASE RATE	\$31.29
FRINGE BENEFITS	16.67

CAMPBELL & PENDLETON COUNTIES:

BRICKLAYERS:

Bricklayers, Caulkers, Cleaners, Pointers & Stonemasons:

BASE RATE	\$25.16
FRINGE BENEFITS	8.39

Refractory:

BASE RATE	\$25.66
FRINGE BENEFITS	8.39

Marble Setters, Terrazzo Workers & Tile Setters:
BUILDING

BASE RATE	\$25.92
FRINGE BENEFITS	7.84

Marble Terrazzo & Tile Finishers: BUILDING

BASE RATE	\$21.48
FRINGE BENEFITS	7.84

Marble Sanders, Polishers, Waxers, & Sawyers:
BUILDING

BASE RATE	\$21.55
FRINGE BENEFITS	7.84

Terrazzo Base Grinders (While operating base grinding machine):
BUILDING

BASE RATE	\$21.90
FRINGE BENEFITS	7.84

CAMPBELL & PENDLETON COUNTIES:

CARPENTERS:

Carpenters & Piledrivermen (Does not include Walls & Ceiling Work):

BUILDING	BASE RATE	\$19.22
	FRINGE BENEFITS	4.77

Carpenters & Lathers (Walls & Ceiling Work Only):

BUILDING	BASE RATE	\$18.99
	FRINGE BENEFITS	4.98

Carpenters & Piledrivermen:

HEAVY & HIGHWAY	BASE RATE	\$22.42
	FRINGE BENEFITS	4.73

Divers:

HEAVY & HIGHWAY	BASE RATE	\$33.63
	FRINGE BENEFITS	4.73

CAMPBELL & PENDLETON COUNTIES:

CEMENT MASONS:

BUILDING	BASE RATE	\$21.00
	FRINGE BENEFITS	7.50

HEAVY & HIGHWAY	BASE RATE	\$24.18
	FRINGE BENEFITS	7.35

CAMPBELL & PENDLETON COUNTIES:

ELECTRICIANS:

Electricians:

	BASE RATE	\$24.24
	FRINGE BENEFITS	9.34

LINE CONSTRUCTION:

Lineman:

BUILDING	BASE RATE	\$24.10
	FRINGE BENEFITS	6.66

Equipment Operator:

BUILDING	BASE RATE	\$21.69
	FRINGE BENEFITS	6.21

Groundman:

BUILDING	BASE RATE	\$15.67
	FRINGE BENEFITS	5.10

SOUND COMMUNICATIONS:

Installer:

	BASE RATE	\$18.00
	FRINGE BENEFITS	3.475

Cable Puller:

	BASE RATE	\$9.00
	FRINGE BENEFITS	2.64

CAMPBELL COUNTY:

LABORERS/BUILDING:(Continued)

Gunnite Nozzle Operator:	BUILDING	BASE RATE	\$22.05
		FRINGE BENEFITS	5.85
Brick Mason Tender:	BUILDING	BASE RATE	\$23.00
		FRINGE BENEFITS	5.85

LABORERS/HEAVY HIGHWAY:

GROUP 1:

Asphalt Laborer; Carpenter Tender; Concrete Curing applicator; Dump Man (Batch Truck); Guardrail and Fence Installer; Joint Setter; Laborer (Construction); Landscape Laborer; Mesh Handlers & Placer; Right-of way Laborer; Riprap Laborer & Grouter; Scaffold Erector; Seal Coating; Surface Treatment or Road Mix Laborer; Sign Installer; Slurry Seal; Utility Man; Bridge Man; Handyman; Waterproofing Laborer; Flagperson; Hazardous Waste (Level D); Diver Tender; Zone Person & Traffic Control:

HEAVY & HIGHWAY	*BASE RATE	\$22.72
	FRINGE BENEFITS	5.85

GROUP 2:

Skid Steer; Asphalt Raker; Concrete Puddler; Kettle Man (Pipeline); Machine Driven Tools (Gas, Electric, Air); Mason Tender; Brick Paver; Mortar Mixer; Power Buggy or Power Wheelbarrow; Sheeting & Shoring Man; Surface Grinder Man; Plastic Fusing Machine Operator; Pug Mill Operator; & Vacuum Devices (wet or dry); Rodding Machine Operator; Diver; Screwman or Paver; Screed Person; Water Blast, Hand Held Wand; Pumps 4" & Under (Gas, Air or Electric) & Hazardous Waste (Level C); Air Track and Wagon Drill; Bottom Person; Cofferdam (below 25 ft. deep); Concrete Saw Person; Cutting with Burning Torch; Form Setter; Hand Spiker (Railroad); Pipelayer; Tunnel Laborer (without air) & Caisson; Underground Person (working in Sewer & Waterline, Cleaning, Repairing & Reconditioning); Sandblaster Nozzle Person; & Hazardous Waste (Level B):

HEAVY & HIGHWAY	*BASE RATE	\$22.89
	FRINGE BENEFITS	5.85

GROUP 3:

Blaster; Mucker; Powder Person; Top Lander; Wrencher (Mechanical Joints & Utility Pipeline); Yarner; Hazardous Waste (Level A); Concrete Crew in Tunnels (With air-pressurized - \$1.00 premium); Curb Setter & Cutter; Grade Checker; Utility Pipeline Tapper; Waterline; and Caulker:

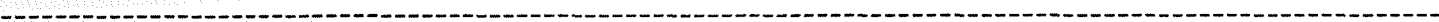
HEAVY & HIGHWAY	*BASE RATE	\$23.22
	FRINGE BENEFITS	5.85

GROUP 4:

Miner (With Air-pressurized - \$1.00 premium); & Gunnite Nozzle Person:

HEAVY & HIGHWAY	*BASE RATE	\$23.67
	FRINGE BENEFITS	5.85

***Signal Person will receive the rate equal to the rate paid the laborer classification for which he or she is signaling.**



PENDLETON COUNTY:

LABORERS/BUILDING:

GROUP 1:

Asbestos Abatement, Carpenter Tender, General, Concrete Pouring & Curing, Concrete Form Stripping & Wrecking, Hand Digging & Backfilling of Ditches, Clearing of Right-of-ways & Building Sites, Wood Sheeting & Shoring, Signalperson for Concrete Bucket, General Cleaning, Toxic Waste Removal, & Environmental Laborer – Nuclear, Radiation, Toxic & Hazardous Waste Level D:

BUILDING	BASE RATE	\$17.83
	FRINGE BENEFITS	7.08

GROUP 2:

Air Tool Operator, Air Track Drill, Asphalt Raker, Tamper, Batch Plant & Scale Man, Chain Saw, Concrete Saw, Electric Hand Grinder, Electric Bush & Chipping Hammer, Flagperson, Forklift Operator, Form Setter (Street or Highway), Gunnite, Hand Spiker, Introflax Burning Rod, Joint Maker, Mason Tender, Pipelayer, Plasterer Tender, Power Driven Georgia Buggy, Power Posthole Digger, Railroad, Sandblaster, Scow Man & Deck Hand, Signalperson, Sweeper & Cleaner Machine, Vibrator Operator, Walk Behind Trenching Machine, Mortar Mixer Machine, Water Pumpman, Metal Form Setter, Heater, Mesh Handler on walkways, Streets & Roadways (Outside Buildings), & Environmental Laborers – Nuclear, Radiation, Toxic & Hazardous Waste – Level C:

BUILDING	BASE RATE	\$18.23
	FRINGE BENEFITS	7.08

GROUP 3:

Gunnite Nozzleman & Gunnite Nozzle Machine Operator, Sand Blaster Nozzleman, Concrete or Grout Pumpman, & Plaster Pumpman:

BUILDING	BASE RATE	\$18.43
	FRINGE BENEFITS	7.08

GROUP 4:

Powderman & Blaster, & Environmental Laborer – Nuclear, Radiation, Toxic & Hazardous Waste – Level B:

BUILDING	BASE RATE	18.53
	FRINGE BENEFITS	7.08

GROUP 5:

Caisson Hole (6 ft & over – Pressure & Free Air Including Tools), Construction Specialist, & Environmental Laborer – Nuclear, Radiation, Toxic & Hazardous Waste – Level A:

BUILDING	BASE RATE	\$19.03
	FRINGE BENEFITS	7.08

PENDLETON COUNTY:

LABORERS/BUILDING (continued)

GROUP 6:

Tunnel Man & Tunnel Sand Miner, Cofferdam (Pressure & Free Air), & Sand Hog or Mucker (Pressure or Free Air):

BUILDING	BASE RATE	\$19.33
	FRINGE BENEFITS	7.08

HEAVY HIGHWAY:

Aging & Curing of Concrete; Asbestos Abatement Worker; Asphalt Plant; Asphalt; Batch Truck Dump; Carpenter Tender; Cement Mason Tender; Cleaning of Machines; Concrete; Demolition; Dredging; Environmental – Nuclear, Radiation, Toxic & Hazardous Waste – Level D; Flagperson; Grade Checker; Hand Digging & Hand Back Filling; Highway Marker Placer; Landscaping, Mesh Handler & Placer; Puddler; Railroad; Rip-rap & Grouter; Right-of-Way; Sign, Guard Rail & Fence Installer; Signal Person; Sound Barrier Installer; Storm & Sanitary Sewer; Swamper; Truck Spotter & Dumper; Wrecking of Concrete Forms; General Cleanup:

HEAVY & HIGHWAY	BASE RATE	\$18.08
	FRINGE BENEFITS	8.63

Batter Board Man (Sanitary & Storm Sewer); Brickmason Tender; Mortar Mixer Operator; Scaffold Builder; Burner & Welder; Bushhammer; Chain Saw Operator; Concrete Saw Operator; Deckhand Scow Man; Dry Cement Handler; Environmental – Nuclear, Radiation, Toxic & Hazardous Waste – Level C; Forklift Operator for Masonry; Form Setter; Green Concrete Cutting; Hand Operated Grouter & Grinder Machine Operator; Jackhammer; Pavement Breaker; Paving Joint Machine; Pipelayer; Plastic Pipe Fusion; Power Driven Georgia Buggy & Wheel Barrow; Power Post Hole Digger; Precast Manhole Setter; Walk-Behind Tamper; Walk-Behind Trencher; Sand Blaster; Concrete Chipper; Surface Grinder; Vibrator Operator; Wagon Driller:

HEAVY & HIGHWAY	BASE RATE	\$18.33
	FRINGE BENEFITS	8.63

Asphalt Luteman & Raker; Gunnite Nozzleman; Gunnite Operator & Mixer; Grout Pump Operator; Side Rail Setter; Rail Paved Ditches; Screw Operator; Tunnel (Free air); Water Blaster:

HEAVY & HIGHWAY	BASE RATE	\$18.38
	FRINGE BENEFITS	8.63

Caisson Worker (Free Air); Cement Finisher; Environmental - Nuclear, Radiation, Toxic & Hazardous Waste - Levels A & B; Miner & Driller (Free Air); Tunnel Blaster; & Tunnel Mucker (Free Air); Directional & Horizontal Boring; Air Track Driller (all types); Powderman & Blaster; Troxler & Concrete Tester if Laborer is Utilized:

HEAVY & HIGHWAY	BASE RATE	\$18.98
	FRINGE BENEFITS	8.63



CAMPBELL & PENDLETON COUNTIES:

MILLWRIGHTS:		BASE RATE	\$21.90
		FRINGE BENEFITS	7.92

CAMPBELL & PENDLETON COUNTIES:

OPERATING ENGINEERS/BUILDING:

Boom & Jib 250' & Over:	BUILDING	BASE RATE	\$28.04
		FRINGE BENEFITS	8.80
Boom & Jib Over 180' through 249':	BUILDING	BASE RATE	\$27.79
		FRINGE BENEFITS	8.80
Boom & Job 150' through 180':	BUILDING	BASE RATE	\$27.29
		FRINGE BENEFITS	8.80
Master Mechanic	BUILDING	BASE RATE	\$27.04
		FRINGE BENEFITS	8.80

Barrier Moving Machine; Boiler or Compressor Mounted on Crane (Piggy-Back Operation); Boom Truck; Cableway; Cherry Picker; Combination Concrete Mixer & Tower; Concrete Pump with Booms; Crane; Derrick; Dragline; Dredge (Dipper, Clam or Suction) 3 Man Crew; Elevating Grader or Euclid Loader; Floating Equipment; Forklift (rough terrain with winch/hoist); Gradeall; Helicopter Operator & Helicopter Winch Operator (Hoisting Builders Materials); Hoe; Hoist (Two or More Drums); Horizontal Directional Drill; Hydraulic Gantry (Lift System); Laser Finishing Machine; Laser Screed and Like Equipment; Lift Slab or Panel Jack; Locomotive; Maintenance Engineer (Mechanic); Mixer, Paving (Multiple Drum); Mobile Concrete Pump with Boom; Panelboard; Pile Driver; Power Shovel; Prentice Loader; Rail Tamper with automatic lifting & align device; Rotary Drill used on Caisson Work for Foundations & Substructure work; Side Boom; Slip Form Paver; Straddle Carrier; Trench Machine (Over 24" Wide); & Tug Boat:

BUILDING	BASE RATE	\$26.79
	FRINGE BENEFITS	8.80

Asphalt Paver; Bobcat-type and/or Skid Steer Loader with Hoe Attachment Greater than 7,000 lbs.; Bulldozer; C.M.I. Type Equipment; Concrete Grinder/Planer; Endloader; Hydro Milling Machine; Kolman Type Loader (Dirt Loading); Lead Greaseman; Mucking Machine; Pettibone-Rail Equipment; Power Grader; Power Scoop; Power Scraper; Push Cat; & Vermeer Type Concrete Saw:

BUILDING	BASE RATE	\$26.67
	FRINGE BENEFITS	8.80

CAMPBELL & PENDLETON COUNTIES:

OPERATING ENGINEERS/BUILDING (Continued):

A-Frame; Air Compressor Pressurizing Shafts or Tunnels; Asphalt Roller (All); Bobcat-type and/or Skid Steer Loader with or without Attachments; Boiler (15 lbs. pressure & over); All Concrete Pumps without Booms & with 5" System; Forklift (Except Masonry); Highway Drills-All Types (with Integral Power); Hoist (One Drum); House Elevator (except those automatic call button controlled); Man Lift; Material Hoist/Elevator; Mud Jack; Pressure Grouting; Pump (Installing or Operating Well Points or other Type of Dewatering Systems); Pump (4" and over Discharge); Railroad Tie Inserter/Remover; Rotovator (Lime soil Stabilizer); Submersible Pump (4" and over Discharge); Switch & Tie Tamper (w/o lifting & aligning device); Trench Machine (24" & under); & Utility:

BUILDING	BASE RATE	\$25.63
	FRINGE BENEFITS	8.80

Ballast Relocator; Backfiller & Tamper; Batch Plant; Bar & Joint Installing Machine; Bull Floats; Burlap & Curing Machines; Clefplanes; Compressor on Building Construction; Concrete Mixer, Capacity more than one bag; Concrete Mixer, one bag capacity (side loader); All Concrete Pumps without Booms with 4" or Smaller System; Concrete Spreading Machine; Conveyor, used for handling building materials; Crusher; Deckhand; Drum Fireman in Asphalt Plant; Farm Type Tractor, Pulling Attachments; Finishing Machines; Form Trencher; Generator; Gunit Machine; Hydro-Seeder; Pavement Breaker (Hydraulic or Cable); Post Driver; Post Hole Digger; Pressure Pump (over 1/2" discharge); Road Widening Trencher; Roller (except Asphalt); Self-propelled Power Spreader; Self-propelled Sub-Grader; Shotcrete Machine; Tire Repairman; Tractor (Pulling Sheep Foot Roller or Grader); VAC/ALL; Vibratory Compactor (with Integral Power) & Welder:

BUILDING	BASE RATE	\$24.45
	FRINGE BENEFITS	8.80

Allen Screed Paver (concrete); Boiler (less than 15 lbs. Pressure); Directional Drill "Locator"; Masonry Fork Lift; Inboard & Outboard Motor Boat Launch; Light Plant; Oiler; Power Driven Heater (Oil Fired); Power Scrubber; Power Sweeper; Pump (Under 4" discharge); Signal Person; & Submersible Pump (Under 4" discharge):

BUILDING	BASE RATE	\$18.99
	FRINGE BENEFITS	8.80

OPERATING ENGINEERS/HEAVY HIGHWAY

Master Mechanic:	HEAVY & HIGHWAY	BASE RATE	\$27.04
		FRINGE BENEFITS	8.80

CAMPBELL & PENDLETON COUNTIES:

OPERATING ENGINEERS/HEAVY HIGHWAY: (Continued):

Air Compressor on Steel Erection; Barrier Moving Machine; Boiler Operator on Compressor or Generator when mounted on a Rig; Cableway; Combination Concrete Mixer & Tower; Concrete Plant (over 4 yd. Cap.); Concrete Pump; Crane (Including Boom Truck, Cherry Picker); Derrick; Dragline; Dredge (Dipper, Clam or Suction); Elevating Grader or Euclid Loader; Floating Equipment; Gradeall; Helicopter Crew (Operator- Hoist or Winch); Hoe; Hoisting Engine on Shaft or Tunnel Work; Horizontal Directional Drill(over 500,000 ft. lbs. thrust) Industrial-Type Tractor; Jet Engine Dryer (D8 or D9) Diesel Tractor; Locomotive (Standard Gauge); Maintenance Operator Class A; Mixer, Paving (Single or Double Drum); Mucking Machine; Multiple Scraper; Piledriving Machine; Power Shovel; Prentice Loader; Quad 9 (Double Pusher); Refrigerating Machine (Freezer Operation); Side-Boom; Slip-Form Paver; Tower Derrick; Tree Shredder; Trench Machine (Over 24" wide); Truck Mounted Concrete Pump; Tug Boat; Tunnel Machine and/or Mining Machine; Wheel Excavator; Hydraulic Gantry (Lifting System); Rail Tamper (w/Auto Lifting & Alignment Device); Rough Terrain Fork Lift with Winch/Hoist:

HEAVY & HIGHWAY	BASE RATE	\$26.79
	FRINGE BENEFITS	8.80

Asphalt Paver; Automatic Subgrader Machine, Self-Propelled (CMI Type); Bobcat Type and/or Skid Steer Loader with Hoe Attachment Greater than 7,000 lbs.; Boring Machine More than 48"; Bulldozer; Endloader; Kolman-type Loader (production type-Dirt); Lead Greaseman; Power Grader; Power Scraper; Push Cat; Trench Machine (24" wide & under); Concrete Grinder/Planer; Pettibone-Rail Equipment; Vermeer type Concrete Saw; Hydro Milling Machine; Lighting & Traffic Signal Installation Equipment; Material Transfer Equipment (shuttle buggy) Asphalt:

HEAVY & HIGHWAY	BASE RATE	\$26.67
	FRINGE BENEFITS	8.80

A-Frame; Air Compressor on Tunnel Work (low pressure); Asphalt Plant Engineer; Locomotive (narrow gauge); Mixer, Concrete (more than one bag cap.); Mixer, one bag cap. (Side Loader); Power Boiler, 15 lb. Pressure & Over; Pump Operator installing & operating Well Points; Pump (4" & over discharge); Roller - Asphalt; Utility Operator (Small equipment); Welding Machine; Bobcat Type and/or Skid Steer Loader with or without Attachments; Switch and Tie Tamper (w/o Lifting & Aligning Device); Highway Drills; Railroad Tie Inserter/Remover; & Rotovator (Lime-Soil Stabilizer):

HEAVY & HIGHWAY	BASE RATE	\$25.63
	FRINGE BENEFITS	8.80

CAMPBELL & PENDLETON COUNTIES:

OPERATING ENGINEERS/HEAVY HIGHWAY (Continued):

Backfiller; Ballast Re-locator; Bars, Joint & Mesh Installing Machine; Batch Plant; Boring Machine Operator (48" or less); Bull Floats; Burlap & Curing Machine; Concrete Plant (capacity 4 yd. & under); Concrete Saw (Multiple); Conveyor (Highway); Crusher; Deckhand; Farm-type Tractor with attachments (highway) except Masonry); Finishing Machine; Fireperson, Floating Equipment (all types); Fork Lift (highway); Form Trencher; Hydro Hammer; Hydro Seeder; Pavement Breaker; Plant Mixer; Post Driver; Post Hole Digger (Power Auger); Power Brush Burner; Power Form Handling Equipment; Road Widening Trencher; Roller (Brick, Grade & Macadam); Self-Propelled Power Spreader; Self-Propelled Power Subgrader; Steam Fireperson; Tractor (Pulling Sheepfoot, Roller or Grader); & Vibratory Compactor with Integral Power:

HEAVY & HIGHWAY	BASE RATE	\$24.45
	FRINGE BENEFITS	8.80

Compressor (Portable, Sewer, Heavy & Highway); Drum Fireperson (Asphalt); Generator; Inboard-Outboard Motor Boat Launch; Masonry Fork Lift; Oil Heater (asphalt plant); Oiler; Power Driven Heater; Power Sweeper & Scrubber; Pump (under 4" discharge); Signalperson; Tire Repairperson; & VAC/ALLS

HEAVY & HIGHWAY	BASE RATE	\$18.99
	FRINGE BENEFITS	8.80

CAMPBELL & PENDLETON COUNTIES:

PAINTERS:

Brush; Roller; Paperhanging & Drywall Taping:

BUILDING	BASE RATE	\$22.15
	FRINGE BENEFITS	5.80

Spray:

BUILDING	BASE RATE	\$22.65
	FRINGE BENEFITS	5.80

Sandblasting; Waterblasting:

BUILDING	BASE RATE	\$22.90
	FRINGE BENEFITS	5.80

Lead Abatement:

BUILDING	BASE RATE	\$23.15
	FRINGE BENEFITS	5.80

Sign Painter & Erector:

BUILDING	BASE RATE	\$17.57
	FRINGE BENEFITS	4.55

Elevated Tanks:

HEAVY & HIGHWAY	BASE RATE	\$22.30
	FRINGE BENEFITS	5.90

CAMPBELL & PENDLETON COUNTIES:

PAINTERS (Continued):

BRIDGES – GUARDRAILS – LIGHTPOLES – STRIPING:

Bridge/Equipment Tender and/or Containment Builder:

HEAVY & HIGHWAY	BASE RATE	\$19.68
	FRINGE BENEFITS	5.80

Brush & Roller:	HEAVY & HIGHWAY	BASE RATE	\$22.15
		FRINGE BENEFITS	5.80

Spray:	HEAVY & HIGHWAY	BASE RATE	\$22.65
		FRINGE BENEFITS	5.80

Sandblasting; Waterblasting:	HEAVY & HIGHWAY	BASE RATE	\$22.90
		FRINGE BENEFITS	5.80

Elevated Tanks; Steeplejack Work; Bridge & Lead Abatement:	HEAVY & HIGHWAY	BASE RATE	\$23.15
		FRINGE BENEFITS	5.80

CAMPBELL & PENDLETON COUNTIES:

PLASTERERS:	BUILDING	BASE RATE	\$20.65
		FRINGE BENEFITS	7.25

CAMPBELL & PENDLETON COUNTIES:

PLUMBERS & PIPEFITTERS:		BASE RATE	\$26.32
		FRINGE BENEFITS	11.72

CAMPBELL & PENDLETON COUNTIES:

ROOFERS (excluding sheetmetal):		BASE RATE	\$24.12
Roofers:		FRINGE BENEFITS	7.62

Pitch:		BASE RATE	\$25.12
		FRINGE BENEFITS	7.62

CAMPBELL COUNTY:

SHEETMETAL WORKERS (including metal roofs):		BASE RATE	\$24.84
		FRINGE BENEFITS	12.55

PENDLETON COUNTY:

SHEETMETAL WORKERS (including metal roofs):	BASE RATE	\$28.40
	FRINGE BENEFITS	11.52

CAMPBELL & PENDLETON COUNTIES:

SPRINKLER FITTERS:	BASE RATE	\$26.05
	FRINGE BENEFITS	11.65

CAMPBELL & PENDLETON COUNTIES:

TRUCK DRIVERS:

3 Tons & Under; Greaser; Tire Changer; & Mechanic Tender: BUILDING	BASE RATE	\$17.52
	FRINGE BENEFITS	8.04

Over 3 Tons; Semi-Trailer or Pole Trailer; Dump Tandem Axles; Farm Tractor (When used to pull building material & equipment):

BUILDING	BASE RATE	\$17.63
	FRINGE BENEFITS	8.04

Concrete Mixer (Hauling on jobsites); & Truck Mechanic:

BUILDING	BASE RATE	\$17.70
	FRINGE BENEFITS	8.04

Euclid's & Other Heavy Moving Equipment; Lowboy; Winch, A-Frame & Monorail Truck (To transport building materials):

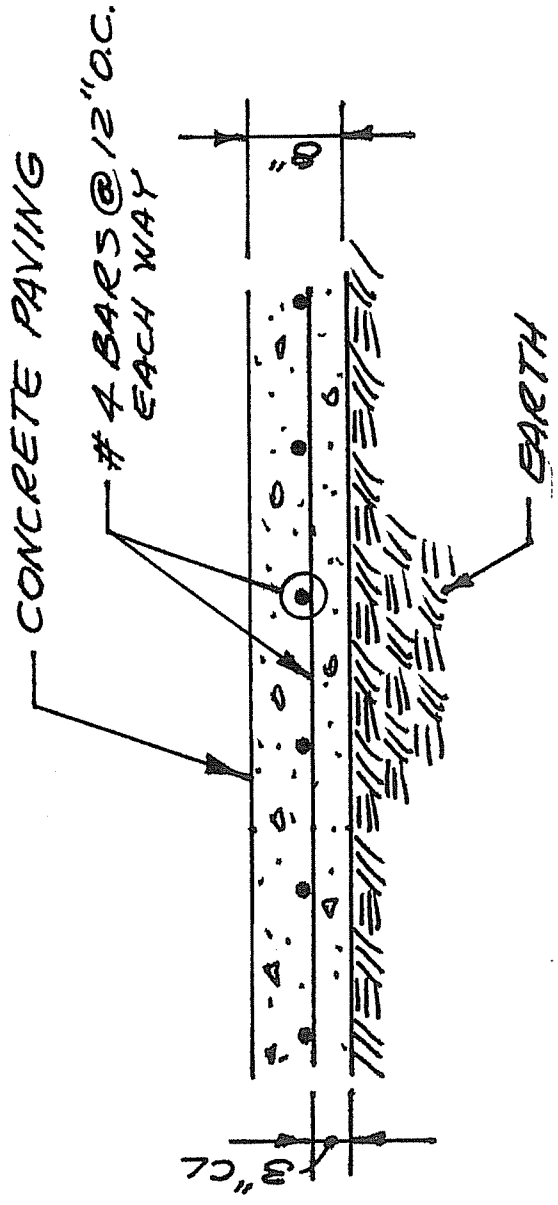
BUILDING	BASE RATE	\$17.80
	FRINGE BENEFITS	8.04

(On hazardous or toxic waste sites, add \$4.00 premium to all of above)

Driver:	HEAVY & HIGHWAY	BASE RATE	\$15.85
		FRINGE BENEFITS	4.60

Euclid Wagon; End Dump; Lowboy; Heavy Duty Equipment; Tractor-Trailer Combination; & Drag:

HEAVY & HIGHWAY	BASE RATE	\$16.29
	FRINGE BENEFITS	4.60



SECTION
Scale: 3/4" = 1'-0"

MPTP CONCRETE PAVEMENT DETAIL

ADDENDUM NO. 2

**MEMORIAL PARKWAY TREATMENT PLANT IMPROVEMENTS
NORTHERN KENTUCKY WATER DISTRICT
August 3, 2006**

All Bidders on the above titled Project are hereby advised of the following modifications to the Specifications and Drawings on the Project. These modifications will be a part of the resulting Contract.

SPECIFICATIONS

Item No. AD2-1: Supplementary Conditions (Section 00800)

Delete Article SC-5.02 (1.)

Item No. AD2-2: Construction Staking (Section 01055)

Delete Article 1.03 (D)

Item No. AD2-3: Water Filter and Appurtenances (Section 01374B)

Revise Article 1.02 (D) (2) to an effective size of 0.35mm

Revise the second sentence of Article 1.02 (K) as follows:

The sand shall have an effective size of 0.45 mm and a uniformity coefficient of 1.4 or less.

Item No. AD2-4: Concrete Work (Section 03010)

Revise Article 2.05(C)(1) as follows:

1. 4,000 psi 28-day compressive strength; 600 lbs cement per cubic yard minimum; W/C ratio 0.44 max. Fly ash substitute not permitted.

Item No. AD2-5: Polyethylene Storage Tanks (Section 11354)

Revise Article 2.01 to include PlasTanks Industries as an acceptable manufacturer.

Item No. AD2-6: Mechanical Insulation and Heat Tracing (Section 15250)

As a clarification, the Caustic Soda bulk tanks need to include an insulated blanket.

Item No. AD2-7: Variable Speed Drives (Section 16489)

Article 2.01 A., delete and replace with the following:

- A. Raw Water Transfer Pump Drives shall be 18-Pulse, AC Drives equal to Allen-Bradley Powerflex series or Eaton Cutler-Hammer CPX 9000 Series.
- B. Metering Hose Pump Drives shall be Allen-Bradley, Eaton Cutler-Hammer or equal.

Item No. AD2-8: Control Panels (Section 17100)

Insert the attached section 17100.

DRAWINGS

Item No. AD2-9: Site Plan & Yard Piping (Sheet C-1)

As a clarification, the New Asphalt pavement identified on the western part of the site is bituminous pavement.

Item No. AD2-10: Raw Water Transfer Pump Station Plan and Sections (Sheet M-1)

In Section M1.2, change the 18" valve on the suction side of the pump to a butterfly valve.

Add an additional 30" Butterfly Valve on the suction line between Pump No. 1 and Pump No. 2

Item No. AD2-11: Ex Sedimentation Basins No. 1 and 2 Demolition Plan (Sheet M-2)

As a clarification, the abandoned steel spindles from the previous chain and flight assembly are to be removed and disposed of by the contractor.

As a clarification the chemical building masonry exterior will be built on top of existing walls on the east, south and west sides. The walkways should be saw cut flush with these existing walls as applicable.

The demolition of the weir wall and channel along the east side of the existing sedimentation basins has been revised as shown in the detail attached to this Addendum.

Item No. AD2-12: Chemical Building Partial Plans (Sheets M-4 through M-7)

The chemical tank bulk and day tank pad heights shown on these Sheets are correct and supercede the dimensions shown for these pad heights on the structural drawings. The appropriate reinforcing for each pad is still detailed on Sheet S-1.

The location of the sump pits for the Spare area and the Caustic Soda area are revised to be installed a minimum of 5'-0" away from the east wall of the Chemical Building.

Item No. AD2-13: Chemical Building Partial Plan PACL - Actiflo Sand Areas (Sheet M-7)

The stairs and landing between the Chemical Building and the Actiflo Building are changed to concrete as shown in the structural and architectural drawings.

Item No. AD2-14: Filter Building Lower Plan (Sheet M-28)

A revised drawing of the piping associated with the existing blowers is attached. Notes 11 and 17 are revised as follows:

11. Connect to existing air piping by cutting in new 8" 90 Deg Elbow. Install new 8" 90 Deg Elbows Outside the building to create gooseneck as shown. Connect back to existing air piping inside building by cutting in new 8" 90 Deg Elbow.
17. Install new 8" electrically actuated butterfly valve to serve as pressure control valve. Connect valve to SCADA system for remote operations.

Item No. AD2-15: Chemical Building Infill and Foundation Plan (Sheet S-1)

A new detail for the east side and west side foundation wall is attached to this Addendum.

Item No. AD2-16: Chemical Building Wall Sections (Sheet A-7)

Modify Section 10/A-7 to have #5 rebars in block wall spaced at 32" on center. Dowel #5 rebars into existing concrete wall 12" and set in epoxy grout. Holes shall be 1 ¼" in diameter.

Item No. AD2-17: Electrical Site Plan (Sheet E-2)

Underground Conduit Tag No. 27 should be Tag No. 4.

Item No. AD2-18: Raw Water Transfer Station Plan – Power and Control (Sheet E-9)

Underground Conduit Tag No. 27 should be Tag No. 4.

Item No. AD2-19: Existing Sludge Handling Facilities – Modifications for RWTS Pump VFDS (Sheet E-10)

Underground Conduit Tag No. 27 should be Tag No. 26.

Item No. AD2-20: Plant Overall One-Line Diagram – Revised (Sheet E-14)

Add the following general note:

The Raw Water Transfer Pump VFDs are to be provided by the pump manufacturer. The Electrical Contractor shall be responsible for receiving, storage, handling, installation and wiring.

END ADDENDUM NO. 2

Part 1 General

1.01 Scope

Control panels.

1.02 Submittals

A. The Contractor shall furnish the following items from the System Manufacturer for approval prior to fabrication:

1. Layout drawings of the front of the panel showing mounting dimensions for all instruments and associated hardware.
2. Assembly drawings shall include:
 - a. Details of panel fabrication including outline dimensions and locations of rear of panel mounted equipment.
 - b. Wiring layout.
 - c. Wiring and tubing interconnection diagrams.
3. Electrical wiring and termination drawings.
4. Complete bill of materials describing all panel components, including manufacturer and complete model number for all components.
5. Catalog cut sheets for all panel components.

1.03 Record Drawings

Submit shop drawings as listed under Article 1.02 above plus operation and maintenance information.

1.04 Delivery, Storage, and Handling

- A. Wrap the completed panel in polyethylene plastic and crate in a wooden shipping crate with sufficient packing to avoid damage in shipment.
- B. Support the base of the shipping crate with the cross members of sufficient strength and clearance to allow movement of the entire crated panel by fork-lift truck.

Part 2 Products

2.01 Enclosure

- A. Provide wall mounted, stanchion mounted, free-standing, or walk-in enclosures as scheduled.
- B. Provide NEMA 12 enclosures for control panels located indoors inside the control room, NEMA 4X Polycarbonate for chemical areas and NEMA 4X stainless steel for outdoor locations (except walk-in) unless otherwise noted.
- C. In all NEMA 4X enclosures outside, provide a thermostat controlled space heater and corrosion inhibitor blocks. Provide NEMA 4X rated devices on front of enclosure or mount devices on interior panel and provide door mounted tempered glass or polycarbonate viewing window.
- D. Free-standing enclosures are a minimum of 20-inches deep.
- E. NEMA 12 and general purpose enclosures shall be fabricated from a minimum 14 gauge steel, unless noted otherwise, with all seams ground smooth, all corners rounded, and all flat surfaces smooth with no ripples, dimples, or surface imperfections and no screws, bolts, or nuts visible from outside. Provide panel stiffeners as required to provide a rigid, non-bowing surface. Thoroughly clean and degrease the steel shell before painting. Apply one coat of a rust inhibiting primer and two coats of air dry enamel or acrylic with flattening agent to produce a smooth semi-gloss finish. Colors are to be chosen by the Engineer.
- F. Install a continuous hinged front access door. For freestanding enclosures, furnish a three point latch. A single point latch is acceptable for wall-mounted enclosures. Wire door mounted instruments and controls to stationary components with suitable flexible connections and protection where wiring crosses the hinge. Provide double or multiple doors as required for stability and smooth mechanical operation.
- G. Terminate all tubing and electrical connections at the bottom of the panel to bulkhead fittings and terminal strips, with all external connections properly identified for field connections. Space shall be provided at the bottom of the panel for excess wiring to be laid out before landing on the associated field terminal strip. Space shall also be provided at the top and sides of the panel for routing cables entering from the top of the panel.
- H. For panels with 120 VAC power supply, provide appropriately sized circuit breaker, single pole, 22,000 AIC, mounted in the rear of the panel to disconnect power. Mount an engraved nameplate (white letters, red background) to read "WARNING – This panel energized by foreign control power sources. Equipment will be live with panel disconnect in either on or off position".
- I. Internal panel sub-feeds of 120 VAC power shall be divided into separate circuits protected by properly sized circuit breakers or fuses. The following separate circuit

divisions shall be provided:

1. Panel light(s) and panel fans (where used).
 2. Each receptacle.
 3. Power to the panel UPS (where supplied).
 4. Thermostatically controlled heaters (where supplied).
 5. Each power supply (including 24-volt power supplies, power supplies for PLCs, power supplies for fiber optic transceivers, etc.).
 6. 120-volt power to field mounted instruments (each instrument shall be provided with a separate circuit).
- J. Provide 1/4 x 12-inch copper ground bus bar(s) in the rear of the panel. All bus bars shall be bonded together. Ground bus shall be capable of accepting System Ground Grid connection and Power System Ground connection.
- K. Provide 20 percent spare, contiguous panel/sub-panel mounting area to accommodate future panel expansion, unless noted otherwise.
- L. The System Manufacturer shall investigate the space allocated for control panels on the accompanying drawings and inform the Engineer of any potential problems.
- M. If indicated in the control panel schedule, control panels shall be provided with a drip shield or heat shield.
1. A 304 stainless steel drip shield shall be provided to prevent ice buildup on the panel door, door hinges, and front of panel-mounted devices. Minimum overhang shall be one inch on the front and side of the panel.
 2. 304 stainless steel heat shields shall be provided to prevent excess heat inside the panel. Shields shall be provided for the top, front, back, and both sides of the panel. Shields shall be mounted to provide one-inch air space between the shield and the panel. Each shield shall have the same height and width as the panel side being protected. Cutouts shall be provided for access to front of panel-mounted devices.
- N. All indicator lights shall be push-to-test. In cases where it is not practical to use push-to-test indicator lights (Engineer's approval required), then a lamp test circuit with a lamp test pushbutton mounted on the front-of-panel shall be provided. Pressing the lamp test pushbutton shall illuminate all indicator lights without interrupting control circuits.

Lamp Colors:	Green	Running, Open
	Red	Stopped, Off, Closed
	Amber	Alarm

Control Panels

- O. Provide one 120 VAC duplex receptacle and fluorescent light(s) as scheduled. Incandescent lights may be used where panel size prohibits the use of fluorescent lights. Provide one standard on/off light switch for the lights. Receptacles and lights shall be provided with a separate circuit breaker and shall be fed from the 120 VAC power supply to the panel. Receptacles and lights shall be fed from uninterruptible power supplies.
- P. All PLC discrete outputs shall have interposing relays installed in the control panel.
- Q. All FRP panels located in direct sunlight shall be provided with at least two coats of UV protective coating to prevent discoloration and cracking.
- R. All control panels shall be either padlockable or have a lock installed in the door handle. All Contractor provided locks shall be keyed alike – consult with the Owner for preferred keying system.
- S. Front of panel devices, such as analog controllers or annunciators, that have rear mounted terminal strips shall be accessible without standing inside the control panel (i.e. mounted on panel door or swing-out panels). Walk-in control panels are excepted.

2.02 Wiring

- A. Install a minimum of #16 AWG copper stranded, 600 volt, extra flexible type for all control wiring 50 volts and above, and a minimum of #18 AWG twisted, shielded pair for analog signal conductors. Color code wires as follows:
 - 1. Ground: Green.
 - 2. Neutral: White.
 - 3. Line Conductor (150 volts or less to ground): Black.
 - 4. Control (150 volts AC or less): Red.
 - 5. Control (150 volts DC or less): Blue.
 - 6. Interlock control circuits supplied from external power source: Yellow or pink.
 - 7. Signal, Shielded and Special Cables: Identify with wire markers.
- B. Mark all wires with approved wire markers at all terminations, per Section 16195. Clearly mark all terminal blocks with typewritten or ink markings. Label all devices mounted on the steel sub-panel. All instrument and control devices (current switches, MiniCAS II relay modules, etc.) located inside control panels shall have engraved lamacoid nametag affixed on or near the device and shall bear the tag number and service description. Label all devices mounted on the panel front with engraved lamacoid nameplates, fastened with screws. Nameplates shall be three-layer laminated plastic, black letters on a white background. Letter height to be

1/8-inch for individual devices and 1/4-inch for panel designation.

- C. Neatly bundle and secure all wiring with plastic ties. Route back-of-panel wiring in slotted plastic wireways with snap-on covers.
- D. Terminal blocks shall be provided for all field wiring connections to the panel. This includes shield terminals for shielded cables. Terminal blocks may be mounted horizontally or vertically and shall be easily accessed from panel door(s). Terminal blocks shall be DIN rail mounted, screw clamp, feed-through type with 600 volt minimum rating. A minimum of 20 percent extra terminals shall be provided on the terminal blocks. Each terminal shall be clearly and permanently marked. Provide fused terminal blocks for all 120 VAC discrete inputs and outputs. All terminal blocks shall be suitably sized for #12 AWG (minimum) stranded wire. All terminal blocks shall be grouped apart, depending upon type of signal per Paragraph E. below.
- E. AC or DC power wiring shall not run in any raceway with any type of instrument wiring. Wiring is to be divided into categories and shall be carried in separate raceways. The minimum acceptable groupings are:
 - 1. 120 VAC, 60 Hz AC power wiring and chart drive power wiring.
 - 2. DC power to electronic instruments (does not include loop powered instruments), contact closure input and output wiring.
 - 3. All wiring carrying pulsed information.
 - 4. Standard range analog DC signals, thermocouple and up to 200 mV DC signals.
 - 5. All intrinsic safe wiring.
- F. It is the responsibility of the System Manufacturer to provide appropriate protection against transients and surges for all field wiring, interfacing with the control panels. This protection equipment shall reside in the appropriate control panel. All instrument analog signal wiring, data transmission wiring, and 120 VAC power supply wiring shall be protected against lightning strikes, and other transient surges at all control panel termination points. All control power wiring, AC control power wiring, I/O cabinet discrete input wiring and discrete output wiring which is routed outside of buildings shall be protected against lightning strikes, and other transient surges at all control panel termination points. Lightning and surge devices shall protect the system from induced surges in analog, discrete and control circuitry and power supply lines. The protective devices shall not interfere with the normal operation of the panel hardware and shall be designed not to have a maximum clamping voltage in excess of what the protected device is capable of withstanding. Protection devices for all internally mounted power supplies shall be installed on individual 120 VAC supply wiring. Each surge/lighting protector shall be independently grounded to the panel ground bus. Protector mounting rail shall not be used to ground the protector.

Control Panels

- G. The System Manufacturer shall provide required hardware and labor for termination of new signals in existing termination cabinets where required. This hardware and workmanship shall match existing work with respect to method, materials, and workmanship.
- H. All control panels furnished under this Section shall carry a UL label which certifies the control panel meets the requirements of UL-508A (latest version).

2.03 Drawings**A. Panel Construction Drawings**

1. Shop Drawings and Catalog Cuts: Provide detailed shop drawings and catalog cuts for all panels, instrument racks, and enclosures. Drawings shall show the location of all front panel and internal sub-panel mounted devices to scale and shall include a panel legend and bill of materials. Layout drawings shall show all major dimensions as well as elevations, in inches from the base up, of all rows of components.
2. The panel legend shall list and identify all front of panel devices by their assigned tag numbers, all nameplate inscriptions, service legends, and annunciator inscriptions. Tag number shall be as listed in the Specifications and Drawings.
3. The bill of materials shall include all devices, including those mounted within the panel that are not listed in the panel legend, and shall include the device tag number, description, manufacturer, and complete model number.

B. Panel Wiring Diagram

1. Provide complete terminal identification of all external primary elements, panels, and junction boxes that interface directly to the panel wiring being shown. Polarity of analog signals shall be shown at each terminal.
2. All external wiring that the electrical contractor must provide and install shall be shown as a dashed line. Special cables that are provided with the instrument shall be clearly identified.
3. Panel wiring diagrams shall identify wire numbers and types, terminal numbers, and tag numbers. Wiring diagrams shall show all circuits individually; no common diagrams will be allowed.
4. Provide panel power wiring diagrams for all panels. The diagrams shall include the grounding requirements.

- C. Interconnecting Wiring Diagrams: Diagrams shall show all component and termination cabinet identification numbers and external wire, fiber, and cable numbers. This diagram shall be coordinated with the electrical supplier and shall bear its mark showing that this has been done.

2.04 Control Panel Schedule

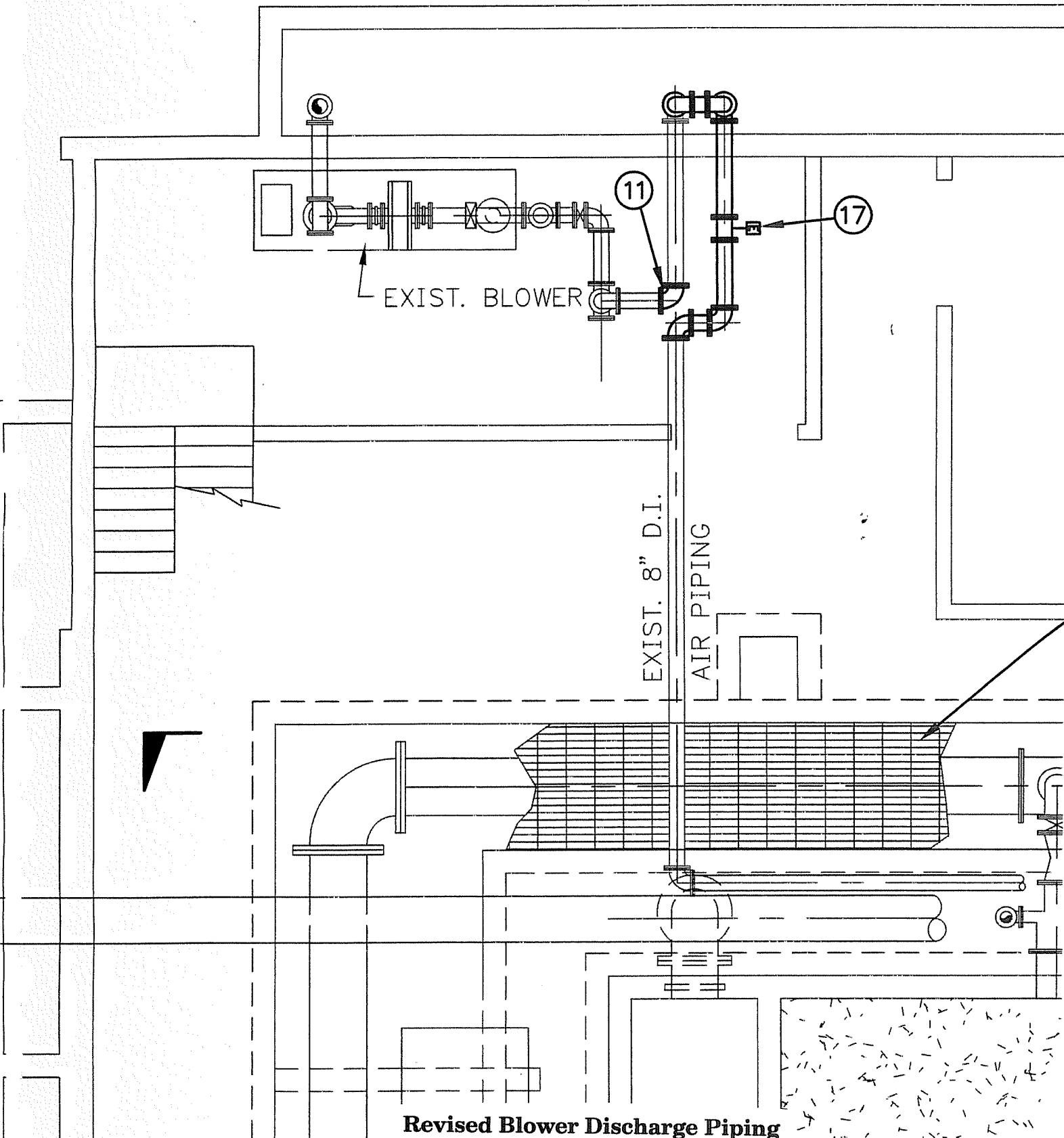
Panel No.	Mounting Type	Enclosure Rating	Light/Receptacle
LCP-CHEM	Free-Standing	NEMA 12	Yes/Yes
LCP-1001	Wall Mounted	NEMA 4X - Poly	No/No
LCP-1002	Wall Mounted	NEMA 4X - Poly	No/No
LCP-1003	Wall Mounted	NEMA 4X - Poly	No/No
LCP-1101	Wall Mounted	NEMA 4X - Poly	No/No
LCP-1102	Wall Mounted	NEMA 4X - Poly	No/No
LCP-1103	Wall Mounted	NEMA 4X - Poly	No/No
LCP-1201	Wall Mounted	NEMA 4X - Poly	No/No
LCP-1202	Wall Mounted	NEMA 4X - Poly	No/No
LCP-1203	Wall Mounted	NEMA 4X - Poly	No/No
LCP-1301	Wall Mounted	NEMA 4X - Poly	No/No
LCP-1302	Wall Mounted	NEMA 4X - Poly	No/No
LCP-1303	Wall Mounted	NEMA 4X - Poly	No/No
LCP-1401	Wall Mounted	NEMA 4X - Poly	No/No
LCP-1402	Wall Mounted	NEMA 4X - Poly	No/No
LCP-1403	Wall Mounted	NEMA 4X - Poly	No/No
LCP-2001	Wall Mounted	NEMA 4X - Poly	No/No
LCP-3101	Wall Mounted	NEMA 4X - Poly	No/No
LCP-3201	Wall Mounted	NEMA 4X - Poly	No/No
LCP-3301	Wall Mounted	NEMA 4X - Poly	No/No
LCP-FILTER	Free-Standing	NEMA 12 - SS	Yes/Yes

Part 3 Execution

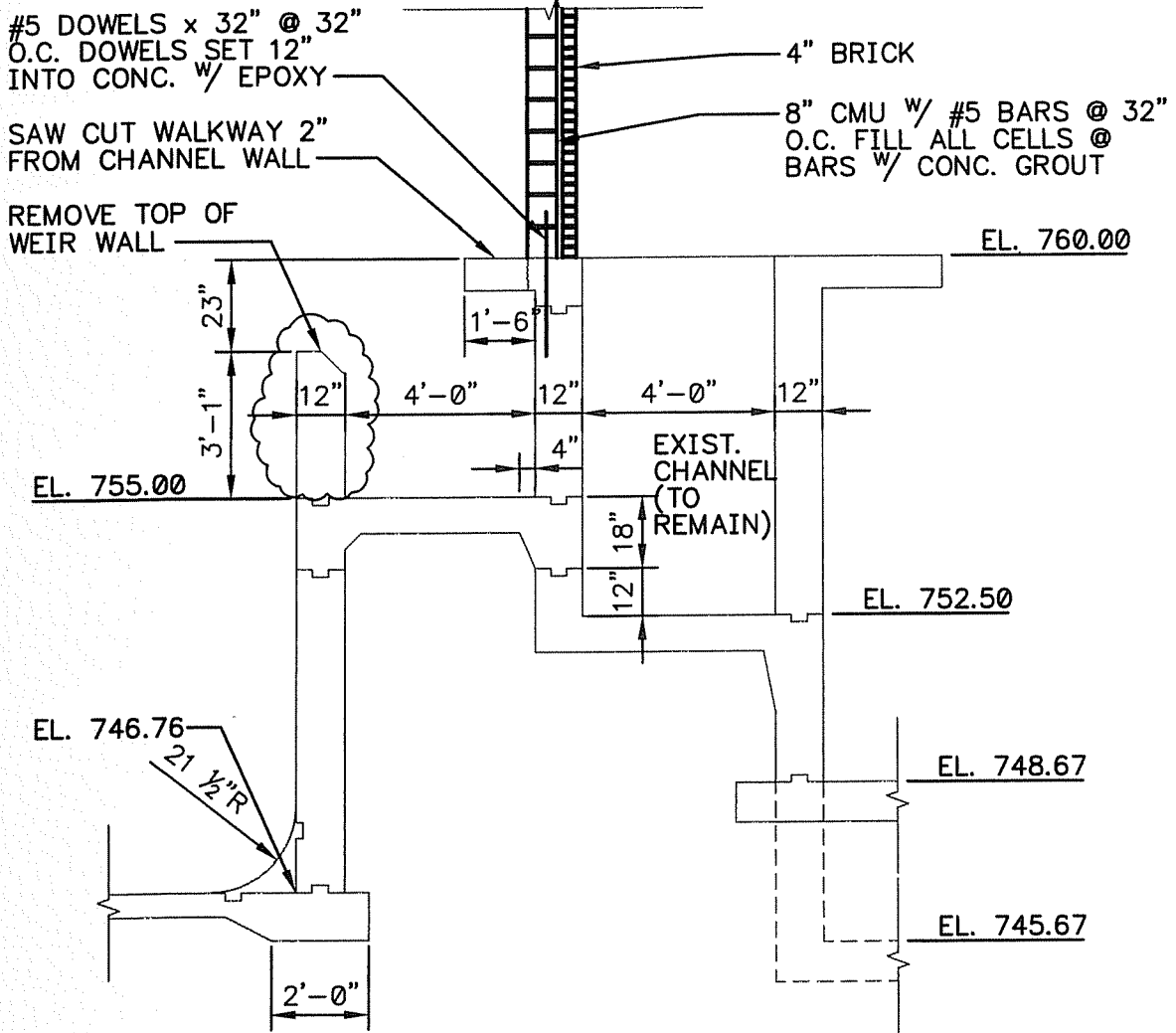
3.01 Testing and Calibration

- A. Thoroughly shop test the completed panel. Confirm that all lamps burn. Remove, box, and label all parts that may come loose or detached in shipment, so that after installation they may be easily replaced.
- B. Perform preliminary calibrations in the fabricator's shop, and final calibrations at start-up by qualified personnel.
- C. For panel layout, front of panel devices and detailed information regarding the components, refer to the Drawings.

END OF SECTION



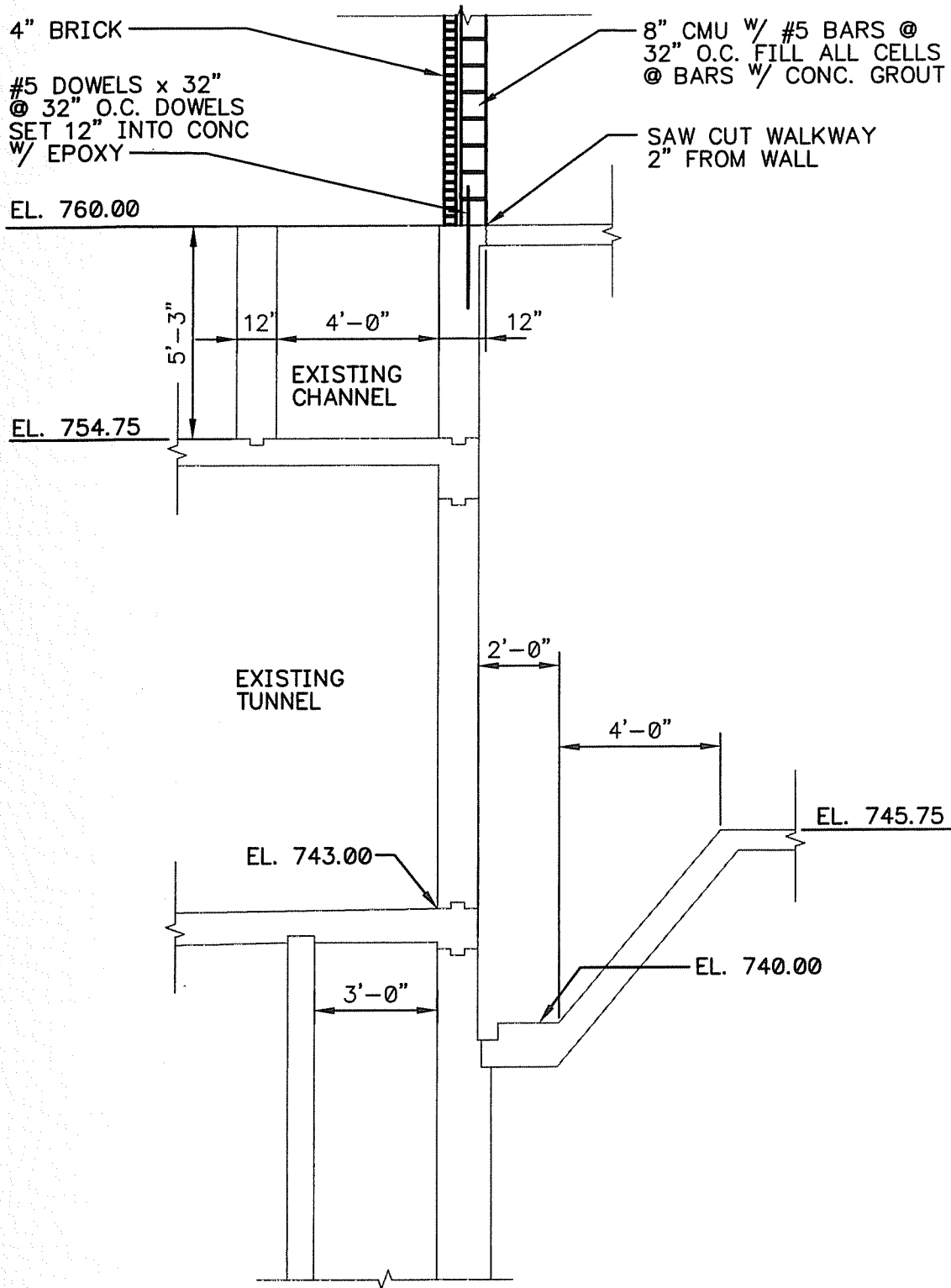
Revised Blower Discharge Piping
Not to Scale



SECTION AT EAST WALL

NTS

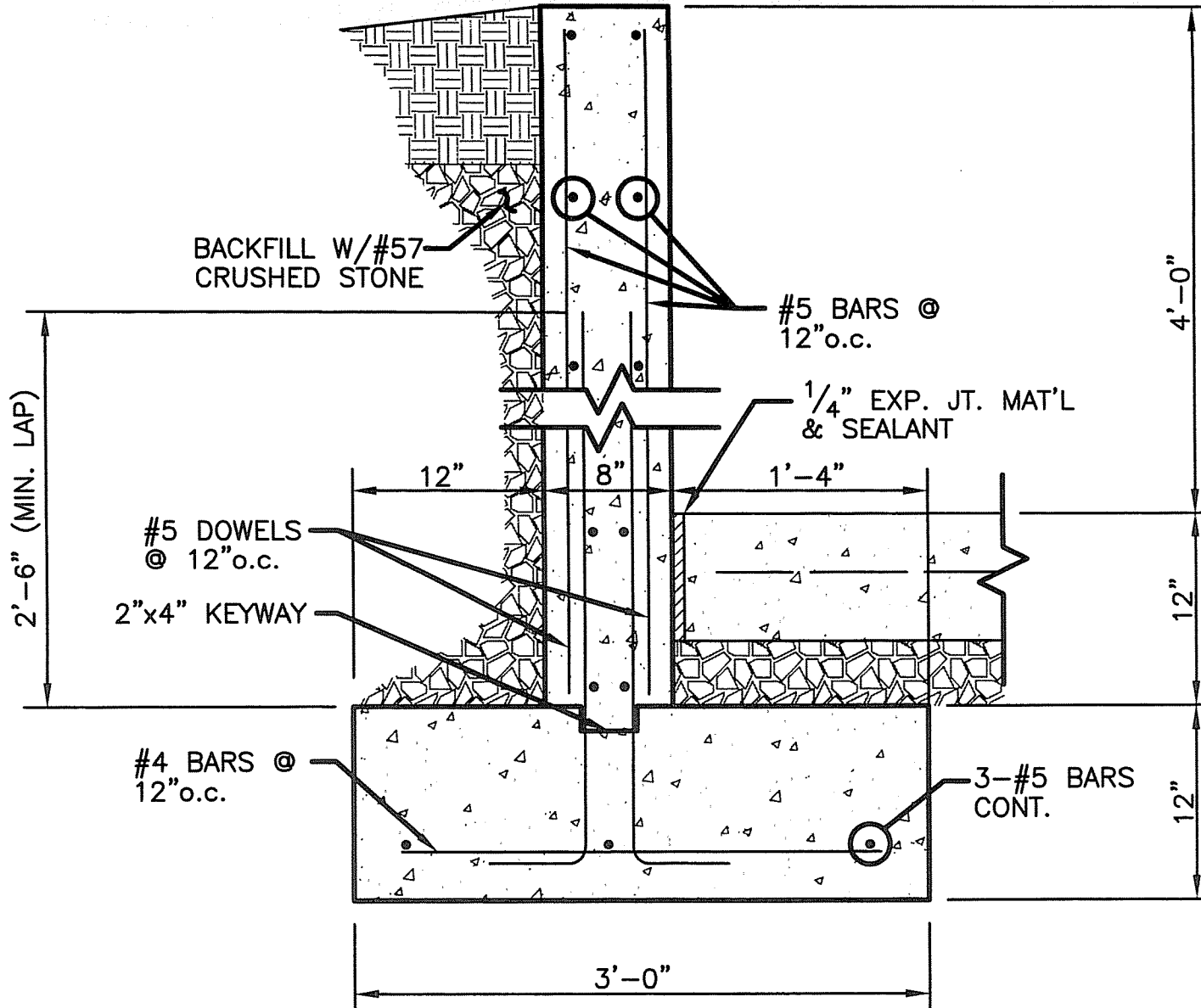
GSN
 DRT.
 4/20
 TUCK



SECTION AT WEST WALL

NTS

Retaining Wall Reinforcing Detail Not to Scale



ADDENDUM NO. 3

**MEMORIAL PARKWAY TREATMENT PLANT IMPROVEMENTS
NORTHERN KENTUCKY WATER DISTRICT**

August 7, 2006

All Bidders on the above titled Project are hereby advised of the following modifications to the Specifications and Drawings on the Project. These modifications will be a part of the resulting Contract.

SPECIFICATIONS

Item No. AD3-1: Horizontal Split Case Pumps(Section 11233)

Delete Goulds Pump as an acceptable manufacturer.

Item No. AD3-1: Addendum No. 2

Revise Addendum No. 2 to show PlasTanks Industries as an acceptable manufacturer for Fiberglass Storage Tanks (Section 13215)

END ADDENDUM NO. 3

Section 00020

INVITATION TO BID

Date: June 29, 2006

PROJECT: MEMORIAL PARKWAY TREATMENT PLANT IMPROVEMENTS

SEALED BIDS WILL BE RECEIVED AT:

Northern Kentucky Water District (Owner)
2835 Crescent Springs Road
Erlanger, Kentucky 41018

UNTIL: Date: August 2, 2006
Time: 2:00 p.m., local time

At said place and time, and promptly thereafter, all Bids that have been duly received will be publicly opened and read aloud.

A non-mandatory Pre-Bid Conference will be held for all Bidders at 10:00 a.m., local time, July 20, 2006, at Memorial Parkway Treatment Plant. All Bidders are encouraged to attend.

The proposed Work is generally described as follows: furnishing all labor, materials, tools, equipment and incidentals and performing all Work required to construct complete in place and ready to operate conversion of an existing sedimentation basin to a new Chemical Storage and Feed Building consisting of approximately 7,800 square feet and associated site work and yard piping, architectural, mechanical, electrical, and instrumentation and control (I&C) work; filter improvements, including removing the existing underdrains and surface wash equipment in three existing filters and replacing the underdrains and installing new sand and anthracite, along with adding air scour capability through a connection to the existing system; replacing existing valves for these three filters and adding electric actuators; improvements to the clearwell including concrete repairs to interior and exterior walls and the top and bottom slab; adding handrail around the perimeter of the top slab; baffling inside the tank to improve hydraulics; relocating the clearwell sample line; new raw water transfer pumps and associated piping modifications, mechanical, electrical, and I&C work; and an alternate bid consisting of a new powdered activated carbon feed system housed in a pre-engineered building.

All Bids must be in accordance with the Instructions to Bidders and Contract Documents on file, and available for examination at: Northern Kentucky Water District, 2835 Crescent Springs Road, Erlanger, Kentucky, 41018; Jordan, Jones & Goulding, Inc., 4219 Harrison Avenue, Cincinnati, Ohio 45211 or Quest Engineers, Inc., 1251 Kemper Meadow Drive, Suite 600, Cincinnati, Ohio, 45240. Copies of the Bidding Documents have also been provided to F.W. Dodge, 7265 Kenwood Road, Suite 200, Cincinnati, Ohio 45236, Telephone (513) 345-8200.

Copies of Bidding Documents shall be obtained from the official document distributor, Lynn Imaging, located at 328 Old Vine Street, Lexington, Kentucky 40507 (859-255-1021 and www.lynnbp.com) upon payment of a non-refundable price of \$350.00 for each

set (including shipping and handling).

Copies of reports of geotechnical explorations can also be purchased from the official document distributor, Lynn Imaging, located at 328 Old Vine Street, Lexington, Kentucky 40507 (859-255-1021 and www.lynnbp.com) upon payment of a non-refundable price of \$20.00 for each copy (including shipping and handling).

Charges for Bidding Documents and mailing and handling, if applicable, will not be refunded.

Bids will be received on a lump sum basis as described in the Contract Documents.

Bid security, in the form of a certified check or Bid Bond in the amount of ten percent (10%) of the maximum total bid price, must accompany each Bid.

The Successful Bidder will be required to furnish a Construction Performance Bond and a Construction Payment Bond as security for the faithful performance and the payment of all bills and obligations arising from the performance of the Contract.

The Successful Bidder and all Subcontractors will be required to conform to the labor standards set forth in the Contract Documents. This project falls under the provisions of KRS 337.505 to 337.550 for prevailing wage rates.

Owner reserves the right to reject any or all Bids, including without limitation the right to reject any or all nonconforming, non-responsive, incomplete, unbalanced, or conditional Bids, to waive informalities, and to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of Owner to make an award to that Bidder. Owner also reserves the right to negotiate with the apparent Successful Bidder to such an extent as may be determined by Owner.

If the Contract is to be awarded, Owner will give the Successful Bidder a Notice of Award within 90 days after the day of bid opening.

On request 72 hours in advance, Owner will provide each Bidder access to the site to conduct such investigations and tests as each Bidder deems necessary for submission of a Bid. Arrangements for site visits shall be made by calling Amy Kramer, Design Engineering Manager, with the Northern Kentucky Water District at (859) 426-2734.

Minority Bidders are encouraged to bid.

Bids shall remain subject to acceptance for 90 days after the day of bid opening or for such longer period of time to which a Bidder may agree in writing upon request of the Owner. If a Contract is to be awarded, the Owner will give the successful Bidder a Notice of Award during the period of time during which the successful Bidder's bid remains subject to acceptance.

Ron Lovan, President/CEO
Northern Kentucky Water District

End of Section

Section 00100

INSTRUCTIONS TO BIDDERS

1. DEFINED TERMS. Terms used in these Instructions to Bidders will have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below which are applicable to both the singular and plural thereof:

- A. *Bidder* - The individual or entity who submits a Bid directly to Owner.
- B. *Successful Bidder* - The lowest responsible Bidder submitting a responsive Bid to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award.

2. COPIES OF CONTRACT DOCUMENTS. Complete sets of Contract Documents must be used in preparing Bids; Bidder shall have sole responsibility for errors or misrepresentations resulting from the use of incomplete sets of Contract Documents.

Owner and Engineer, in making copies of Contract Documents available, do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

3. QUALIFICATIONS OF BIDDERS. To demonstrate Bidder's qualifications to perform the Work, within five days of Owner's request Bidder shall submit written evidence such as financial data, previous experience, present commitments, and such other data as may be requested by Owner. Bidders who have not, in the Owner's opinion, had sufficient experience in the size and type of work involved to be considered responsible Bidders will not be considered.

4. EXAMINATION OF CONTRACT DOCUMENTS AND SITE. It is the responsibility of each Bidder, before submitting a Bid, to:

- a. thoroughly examine and study the Instructions to Bidders and the Contract Documents, including any Addenda;
- b. visit the Site and become familiar with and satisfy Bidder as to the general, local, and site conditions that may affect cost, progress, performance, or furnishing of the Work;
- c. become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, performance, or furnishing of the Work;
- d. agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times and in accordance with the other terms and conditions of the Contract Documents;
- e. correlate the information known to Bidder, information and observations obtained from visits to the Site, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents;

- f. promptly give Owner written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Contract Documents and confirm that the written resolution thereof by Owner is acceptable to Bidder; and
- g. determine that the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.

4.01. Underground Facilities. Information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner or others, and Owner and Engineer disclaim responsibility for the accuracy or completeness thereof, unless it is expressly provided otherwise in the Supplementary Conditions.

4.02. Additional Information. Before submitting a Bid, each Bidder may, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests, and studies and obtain any additional information and data which pertain to subsurface or physical conditions at or contiguous to the Site or otherwise, which may affect cost, progress, performance, or furnishing of the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of the Contract Documents.

On request 72 hours in advance, Owner will provide each Bidder access to the Site to conduct such explorations and tests as each Bidder deems necessary for submission of a Bid. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations. Arrangements for Site visits shall be made by calling Amy Kramer, Design Engineering Manager, with the Northern Kentucky Water District at (859) 426-2734.

4.03. Bidder's Representation. The submission of a Bid will constitute an incontrovertible representation and covenant by Bidder that Bidder has complied with every requirement concerning examination of the Contract Documents and the site; that without exception the Bid is premised upon performing and furnishing the Work required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

5. SITE AND OTHER AREAS. The Site is identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment to be incorporated in the Work are to be obtained and paid for by Contractor. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Contract Documents.

6. INTERPRETATIONS AND ADDENDA. All questions about the meaning or intent of the Contract Documents are to be submitted in writing to Mr. Brent Tippey, Quest Engineers, Inc., 2517 Sir Barton Way, Lexington, Kentucky 40509, e-mail: btippey@questeng.com, fax 859-223-3150. Any interpretations or clarifications that are considered necessary by Engineer in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Engineer as having received the Contract Documents. Questions received less than seven days prior to the date for opening of Bids may not be answered. The person submitting questions shall be responsible for their prompt delivery. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

Addenda may be issued to clarify, correct, or change the Contract Documents as deemed advisable by Owner or Engineer.

Owner and Engineer will not be responsible for explanations or interpretations of the Contract Documents or Contract Documents except as issued in accordance herewith.

7. BID SECURITY. Each Bid must be accompanied by Bid security made payable without condition to Owner in an amount of 10 percent of Bidder's maximum Bid and in the form of a Bid Bond (on the form attached) issued by a surety meeting the requirements as set forth in the General Conditions and Supplementary Conditions.

Bid security of the Successful Bidder will be retained until such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may annul the Notice of Award and Bid security of that Bidder will be forfeited. Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the later of seven days after the Effective Date of the Agreement or one day after the last day the Bids remain subject to acceptance, whereupon Bid security furnished by such Bidders will be returned.

8. CONTRACT TIMES. The numbers of days within which, or the dates by which, the Work is to be (a) Substantially Completed and (b) also completed and ready for final payment are set forth in the Agreement.

9. LIQUIDATED DAMAGES. Provisions for liquidated damages, if any, are set forth in the Agreement.

10. SUBSTITUTE OR "OR-EQUAL" ITEMS. The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Contract Documents without consideration of possible substitute or "or-equal" items. Whenever it is specified or described in the Contract Documents that a substitute or "or-equal" item of material or equipment may be furnished or used by Contractor if acceptable to Owner, application for such acceptance will not be considered by Owner until after the Effective Date of the Agreement. The procedure for submission of any such application by Contractor and consideration by Owner is set forth in the General Conditions and may be supplemented in the General Requirements.

11. SUBCONTRACTORS, SUPPLIERS, AND OTHERS. Each Bidder shall submit with its Bid the name of all such Subcontractors, Suppliers, and other individuals and organizations proposed for those portions of the Work for which such identification is required. If, after due investigation, Owner or Engineer has reasonable objection to any proposed Subcontractor, Supplier, or other individual or entity, Owner or Engineer may, before the Notice of Award is given, request the apparent Successful Bidder to submit an acceptable substitute without an increase in the Bid. If the apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use an acceptable Subcontractor, Supplier, or other individual or entity. Declining to make requested substitutions will not constitute grounds for sacrificing the bid security of any Bidder. Any Subcontractors, Suppliers, or other individual or entity to whom the Owner or Engineer does not make written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to revocation of such acceptance as provided in

the General Conditions. Preliminary acceptance of equipment listed by manufacturer's name shall not in any way constitute a waiver of the specifications covering such equipment; final acceptance will be based on full conformity with the Contract Documents. Any Bid conditioned on furnishing equipment or materials which are not responsive to the Contract Documents will be rejected.

12. PREPARATION OF BID. The Bid Form is included with the Contract Documents.

All blanks on the Bid form shall be completed by printing in ink or by typewriter and the Bid signed. A Bid price shall be indicated for each lump sum bid item listed therein, or the words "No Bid", "No Change", or "Not Applicable" entered.

A Bid by a corporation shall be executed in the corporate name by the president or a vice-president or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown below the signature.

A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be shown below the signature.

A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown below the signature.

A Bid by an individual shall show the Bidder's name and official address.

A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid form. The official address of the joint venture must be shown below the signature.

All names shall be typed or printed in ink below the signatures.

The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid form.

The address and telephone number for communications regarding the Bid shall be shown.

13. BID PRICING. The lump sum price shall be based on the Work as indicated in the Contract Documents.

14. SUBMITTAL OF BID. A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the advertisement or invitation to Bid and shall be enclosed in an opaque sealed envelope plainly marked with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate envelope plainly marked on the outside with the notation "Bid Enclosed".

Bids shall be addressed to Owner at:

Northern Kentucky Water District

P.O. Box 18640
2835 Crescent Springs Road
Erlanger, Kentucky 41018

One executed set of the Bid Form along with the Statement of Bidder's Qualifications, Corporate Certificate, Contractor's License Certification, a Non-Collusion Affidavit, the Bid Bond and forms identified in Paragraph 22 of this Section, shall be submitted. Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids. Bids received after the time and date for receipt of Bids may be returned unopened. Oral, telephone, facsimile, or telegraph Bids are invalid and will not receive consideration.

If included with the Contract Documents, Bidder shall prepare and submit with its Bid the Questionnaire listing the Suppliers and manufacturers of items of equipment and materials that Bidder proposes to furnish.

15. MODIFICATION AND WITHDRAWAL OF BIDS. A Bid may be modified or withdrawn by an appropriate document duly executed in the manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned.

16. OPENING OF BIDS. Bids will be opened at the time and place indicated in the Invitation to Bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

17. BIDS TO REMAIN SUBJECT TO ACCEPTANCE. All Bids will remain subject to acceptance for the period of time stated in the Bid form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

18. AWARD OF CONTRACT. Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, non-responsive, incomplete, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder which it finds, after reasonable inquiry and evaluation, to be non-responsive. Owner may also reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Owner to make an award to that Bidder. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate with the apparent Successful Bidder to such an extent as may be determined by Owner.

In evaluating Bids, Owner will consider the following:

1. Whether or not the Bid complies with the prescribed requirements, and provides such alternates, unit prices and other information or data as may be requested in the Bid Form or prior to the Notice of Award.
2. The qualifications of the Bidder and the qualifications of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted. Owner may also consider operating costs, maintenance requirements, performance data, and guarantees of major items of materials and equipment

proposed for incorporation in the Work when such data are required to be submitted prior to the Notice of Award.

3. If the Bidder maintains a permanent place of business.
4. If the Bidder has adequate personnel, plant and equipment to perform the Work properly and expeditiously.
5. Bidder's financial status to meet all obligations and incidentals to the Work.
6. Whether the Bidder has appropriate technical expertise and experience.
7. Bidder's performance record.
8. The amount of the Bid.

Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders to perform the Work in accordance with the *Contract Documents*.

19. CONTRACT SECURITY AND INSURANCE. The General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment Bonds and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by such Bonds and insurance certificates.

20. SIGNING OF AGREEMENT. When Owner gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement with the other Contract Documents identified in the Agreement as attached thereto. Within 15 days thereafter, the Successful Bidder shall sign, leaving the dates blank, and deliver the required number of counterparts of the Agreement and attached documents to Owner. Within 15 days thereafter, Owner shall deliver one fully signed counterpart to the Successful Bidder with a complete set of the Drawings with appropriate identification.

21. RETAINAGE. Provisions concerning retainage are set forth in the Agreement.

22. DRINKING WATER STATE REVOLVING FUND LOAN.

- A. A portion of the funding for this project comes from a Drinking Water State Revolving Fund (DWSRF) loan. This loan originates with the United States Environmental Protection (USEPA) and has several provisions that directly impact the Bidder. These include:

1. A certification that the Bidder, and any subcontractors used by the Bidder, are not on the Federal List of Debarred Contractors. (CERTIFICATION REGARDING DEBARMENT, SUSPENSION AND OTHER MATTERS – EPA Form 5700-49) addresses this item and must be executed and included with the Bid.
 2. A certification that the Bidder that no appropriated funds were or will be used for the purposes of lobbying the legislative or executive branches of the Federal government. (CERTIFICATION REGARDING LOBBYING) addresses this item and must be submitted with the Bid.
 3. A requirement to utilize minority or women owned businesses as subcontractors where possible. Bidders are required to make positive efforts towards this end and document the steps taken to encourage their participation. (MBE/WBE DATA SHEET I) addresses this item and must be filled out and submitted with the Bid.
- B. The DWSRF loan creates additional documentation requirements on both the Contractor and the Owner. These are set forth in the Supplemental General Conditions for Drinking Water State Revolving Fund Loans (DWSRF Supplemental General Conditions). The items identified in Paragraph 22.A of this section must be submitted with the Bid. The remaining items identified in the DWSRF Supplemental General Conditions Section will be submitted by the low bidder within 21 days of the Bid opening. The project will not be awarded until this information is received.

End of Section

Section 00300

BID FORM

PROJECT IDENTIFICATION:

Memorial Parkway Treatment Plant Improvements

THIS BID IS SUBMITTED TO:

Northern Kentucky Water District
2835 Crescent Springs Road
Erlanger, Kentucky 41018

1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Contract Documents to perform all Work as specified or indicated in the Contract Documents within the time indicated and for the amount indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

2. Bidder accepts all of the terms and conditions of the Invitation to Bid and the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 90 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner. Bidder understands that certain extensions to the time for acceptance of this Bid may require the consent of the surety for the Bid Bond.

3. In submitting this Bid, Bidder represents and covenants, as set forth in the Agreement, that:

a. Bidder has examined and carefully studied the Contract Documents, the other related data identified in the Contract Documents, and the following Addenda, receipt of all of which is hereby acknowledged:

- No. _____ Dated _____
- No. _____ Dated _____
- No. _____ Dated _____
- No. _____ Dated _____
- No. _____ Dated _____
- No. _____ Dated _____

b. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

- c. Bidder is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.
 - d. Bidder has obtained and carefully studied (or assumes responsibility for having done so) all additional or supplementary explorations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents to be employed by Bidder, and safety precautions and programs incident thereto.
 - e. Bidder does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Contract Documents.
 - f. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
 - g. Bidder has correlated the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.
 - h. Bidder has given Owner written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Contract Documents, and the written resolution thereof by Owner is acceptable to Bidder.
 - i. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.
4. Bidder further represents that this Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization, or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any individual or entity to refrain from bidding; and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over Owner.

5. Bidder will complete the Work for the following price:

*** BASE BID ***

ITEM 1 – Furnishing all products, materials and equipment and performing all labor necessary to complete and put into operation the Memorial Parkway Treatment Plant Improvements, including all work shown on the Drawings and/or specified and not included in Item 2 below, nor the Alternate the amount of: \$ _____ (in numbers) and _____ DOLLARS (in words).

ITEM 2 - CONCRETE RESTORATION

a.	800	SQ.FT.	Interior Vertical Surfaces	\$ _____/SF	\$ _____
b.	600	SQ.FT.	Exterior Vertical Surfaces	\$ _____/SF	\$ _____
c.	1,800	SQ.FT.	Underside of Beams and Slabs	\$ _____/SF	\$ _____

BASE BID TOTAL, ITEMS 1 THROUGH 2, INCLUSIVE, THE AMOUNT OF \$ _____ (in numbers) and _____ DOLLARS (in words).

*** ALTERNATE BID ***

Add, for constructing the powdered activated carbon feed system housed in a pre-engineered metal building as shown on the Drawings and as specified, the Lump Sum Amount of \$ _____ (in numbers) and _____ DOLLARS (in words).

6. Bidder agrees that the Work will be substantially complete within 330 calendar days, and completed and ready for final payment in accordance with paragraph 14.07.B of the General Conditions within 360 calendar days, after the date when the Contract Times commence to run as defined in the General Conditions.

7. Communications concerning this Bid shall be sent to Bidder at the following address:

8. The terms used in this Bid, which are defined in the General Conditions included as part of the Contract Documents, have the meanings assigned to them in the General Conditions.

SIGNATURE OF BIDDER

If an Individual

Name (typed or printed): _____

By _____ (SEAL)
(Individual's signature)

doing business as _____

Business address _____

Phone No.: _____ Fax No.: _____

Date _____

If a Partnership

Partnership Name: _____ (SEAL)

By _____
(Signature of general partner - attach evidence of authority to sign)

Name (typed or printed): _____

Business address _____

Phone No. _____ Fax No.: _____

Date _____

If a Corporation

Corporation Name: _____ (SEAL)

State of Incorporation: _____

Type (General, Professional, Service, Limited Liability): _____

By _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

(CORPORATE SEAL)

Attest _____

Business address _____

Phone No. _____ Fax No.: _____

Date _____

If a Joint Venture

(Each joint venturer must sign. The manner for signing for each individual, partnership, and corporation that is party to the joint venture should be in the manner indicated above.)

Joint Venturer Name: _____ (SEAL)

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

Phone No.: _____ Fax No.: _____

Joint Venturer Name: _____ (SEAL)

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

Phone No.: _____ Fax No.: _____

Date _____

Section 00400

SUPPLEMENT TO BID FORM

1. FORMS TO BE SUBMITTED WITH BID. A portion of the funding for this project comes from a Drinking Water State Revolving Fund (DWSRF) loan. This loan originates with the United States Environmental Protection (USEPA) and has several provisions that directly impact the Bidder. The items identified in Item 1 of this section must be submitted with the Bid. These include:

- a. A certification that the Bidder, and any subcontractors used by the Bidder, are not on the Federal List of Debarred Contractors. Attachment No. 1 (CERTIFICATION REGARDING DEBARMENT, SUSPENSION AND OTHER MATTERS – EPA Form 5700-49) in Section 00400 addresses this item and must be executed and included with the Bid.
- b. A certification by the Bidder that no appropriated funds were or will be used for the purposes of lobbying the legislative or executive branches of the Federal government. Attachment No. 2 (CERTIFICATION REGARDING LOBBYING) in Section 00400 addresses this item and must be submitted with the Bid.
- c. A requirement to utilize minority or women owned businesses as subcontractors where possible. Bidders are required to make positive efforts towards this end and document the steps taken to encourage their participation. Attachment No. 3 (MBE/WBE DATA SHEET I) in Section 00400 addresses this item and must be filled out and submitted with the Bid.

2. FORMS TO BE SUBMITTED BY APPARENT LOW BIDDER AFTER BID OPENING. The DWSRF loan creates additional documentation requirements on both the Contractor and the Owner. These are set forth in the Supplemental General Conditions for Drinking Water State Revolving Fund Loans (DWSRF Supplemental General Conditions). The remaining items identified in the DWSRF Supplemental General Conditions Section will be submitted by the apparent low bidder within 21 days of the Bid opening. The project will not be awarded until this information is received.

CERTIFICATIONS

Debarred Firms

All prime Construction Contractors shall certify that Subcontractors have not and will not be awarded to any firm that is currently on the EPA Master List of Debarred, Suspended and Voluntarily Excluded Persons in accordance with the provisions of 40 CFR 32.500(c). Debarment action is taken against a firm for noncompliance with Federal Law.

All bidders shall complete the attached certification (Attachment Number 10) and submit to the owner with the bid proposal.

Anti-lobbying Certification

All prime Construction Contractors must certify (Attachment Number 11) that no appropriated funds were or will be expended for the purpose of lobbying the Executive or Legislative Branches of the Federal Government or Federal Agency concerning this contract (contract in excess of \$100,000). If the Contractor has made or agreed to make payment to influence any member of Congress in regard to award of this contract, a Disclosure Form must be completed and submitted to the owner with the bid proposal.

All prime Contractors must require all Subcontractors to submit the certification, which must also be submitted to the owner.

**CERTIFICATION REGARDING DEBARMENT,
SUSPENSION AND OTHER RESPONSIBILITY MATTERS**

The prospective participant certifies to the best of its knowledge and belief that it and its principals:

(A) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(b) Have not within a three year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. In addition, under 18 USC Sec. 1001, a false statement may result in a fine of up to \$10,000 or imprisonment for up to 5 years, or both.

Typed Name & Title of Authorized Representative

Signature of Authorized Representative

Date

____ I am unable to certify to the above statements. My explanation is attached.

CERTIFICATION REGARDING LOBBYING
Certification for Contracts, Grants,
Loans, and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

TYPED NAME & TITLE OF AUTHORIZED REPRESENTATIVE

SIGNATURE OF AUTHORIZED REPRESENTATIVE DATE

____ I am unable to certify to the above statements. My explanation is attached.

UTILIZATION OF SMALL, MINORITY AND WOMEN'S BUSINESSES

The provisions of PL 102-389 and EPA's implementing regulation 40 CFR 31.36(e) require recipients of Federal assistance to award a fair share of sub-agreements to small, small rural, minority and women's businesses on contracts and sub-agreement performed under EPA Assistance Agreements.

The following procedures are to be followed for procurement under EPA Assistance Agreements.

The successful bidder must submit to the grantee within 10 days after bid opening, evidence of the positive steps taken to utilize small, minority and women's businesses. Information should include the following:

EPA Project Number. Project Location. Type of Construction.

List of current construction contracts, with dollar amount. List contracting Federal Agency, if applicable.

List of subcontractors (name, address and telephone) with dollar amount and duration of subcontract.

List of any subcontract work yet to be committed with estimate of dollar amount and duration of contract.

Contract Price. Duration of prime contract.

Such positive efforts shall include:

- (1) Placing qualified small and minority businesses and women's business enterprises on solicitation lists;
- (2) Assuring that small and minority businesses, and women's business enterprises are solicited whenever they are potential sources;
- (3) Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority business, and women's business enterprises;
- (4) Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority business, and women's business enterprises;
- (5) Using the services and assistance of the Small Business Administration, and the Minority Business Development Agency of the Department of Commerce; and
- (6) Requiring each party to a sub-agreement to take the affirmative steps listed in paragraphs 1 through 5 of this section.

For purposes of clarification:

" This requirement applies to any EPA Financially assisted procurement.

" This requirement mandates three responsibilities. Separate solicitations must be made of small, small rural, minority and women's businesses enterprises.

" A minority business is a business, at least 51 percent of which is owned and controlled by minority group members (Black; Hispanic; Asian American; American Indian; and any other designations approved by the Office of Management and Budget that are U.S. citizens. Any specific clarification concerning the ownership and/or control issues will be provided by the EPA Regional Office.

" A women's business is a business, at least 51 percent of which is owned and controlled by one or more women who are U.S. citizens.

" The control determination will revolve around the minority or women owner's involvement in the day-to-day management of the business enterprise.

" Solicitation should allow adequate time for price analysis; EPA recommends that contact be made no later than 15 days before bid opening.

" Efforts taken to comply with this requirement must be documented in detail; maintain records of firms contacted, including any negotiation efforts to reach competitive price levels, and awards to the designated firms.

" Any proposed changes from the approved Minority/Women/Small business participation after EEO/MBE approval shall be reported to EPA prior to initiation of the action, with the reason for the proposed deviation.

" The EPA recommends that the grantee as well as the prime contractor utilize the services of the following agencies to find information on certified Minority/Women/Small business. Use of these services does not absolve the prime contractors from pursuing additional efforts to comply with this requirement.

Minority Business Development Service Centers These Centers are funded by the U.S. Department of Commerce to provide technical, financial and contracting assistance to minority, women's and small rural business enterprises. The locations of the Centers are available by selecting the appropriate Minority Business Development Agency regional office from: <http://www.mbdba.gov/>.

U.S. Small Business Administration Central Contractor Registration (procurement marketing and access network) at <http://www.ccr.gov/>.

U.S. Small Business Administration (SBA) Online Women's Business Center. For the Women's Business Center nearest you, go to: <http://www.onlinewbc.gov/> and select Women's Business Centers.

For additional information on listings of certified MBE/WBE contractors and subcontractors in the States of Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee, contact Rafael Santamaria in EPA Region 4 at 404 562-8312.

S P E C I F I C A T I O N S

FOR

NORTHERN KENTUCKY WATER DISTRICT

**Memorial Parkway Treatment Plant
Improvements**

JULY 2006

RON LOVAN, PRESIDENT/CEO

COMMISSIONERS:

**JOE KOESTER - CHAIRPERSON
ANDREW COLLINS - SECRETARY
FRED MACKE, JR. - TREASURER
PAT SOMMERKAMP - COMMISSIONER
FRANK JACKSON - COMMISSIONER
DOUG WAGNER - COMMISSIONER**

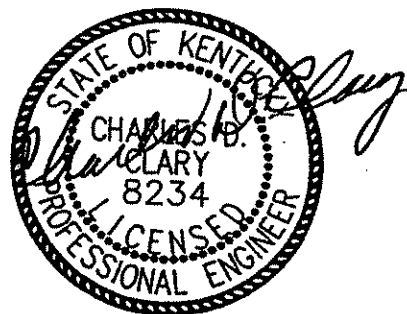
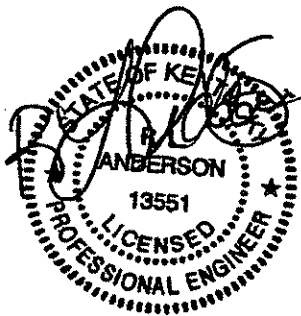
CHARLES PANGBURN - ATTORNEY



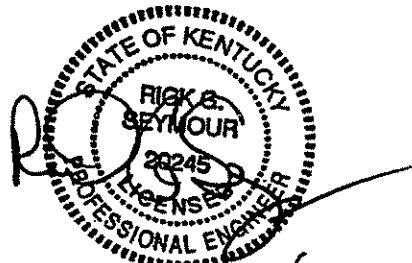
MEMORIAL PARKWAY TREATMENT PLANT IMPROVEMENTS

NORTHERN KENTUCKY WATER DISTRICT

FORT THOMAS, KENTUCKY



4-4-06



4/27/06



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Part 1 General**1.01 Description**

- A. Soil boring logs are shown in the Thelen Associates, Inc. report entitled "Geotechnical Exploration, Proposed Chemical Storage and Feed Systems Improvements, Northern Kentucky Water District, Memorial Parkway Plant, Ft. Thomas, Kentucky" dated November 14, 2005, (Job Number 050916E). This information may be obtained upon request at the offices of the Engineer.
- B. This soil investigation information is offered as an aid in bidding only and is not a part of the Contract Documents. The boring logs are available for the Contractor's information, but are not a warranty of subsurface conditions. The Owner, Engineer and geotechnical engineer assume no responsibility for any variation between materials encountered during construction and those indicated on the boring logs, nor for any variation between the location of the water table encountered and that indicated on the boring logs at the date borings were taken.
- C. Additional Investigation: The Contractor shall visit the site and become acquainted with site conditions. Prior to bidding, prospective Contractors may make their own site and subsurface investigations to satisfy themselves with site and subsurface conditions. The Contractor shall be responsible for obtaining rights of ingress and egress to private property for site and subsurface investigation and shall assume all responsibility for any damage to property caused as a result of the Contractor's investigation.
- D. Location of Borings: Contractors shall be responsible for making their own determination of the location of the soil borings on this Project.

END OF SECTION



Part 1 General

1.01 Description

- A. Copies of various drawings of existing facilities from previous construction projects are available for the Contractor's use in evaluating the magnitude of demolition required by the Contract Documents. This information may be obtained upon request at the offices of the Engineer.
- B. Details of the extent of demolition are shown on the Drawings and in Section 02060 and Section 02073 of these Specifications.
- C. These drawings are offered as a convenience and an aid in bidding only and are not a part of the Contract Documents. The Owner and Engineer make no warranty that these drawings are record drawings or accurately depict the actual construction or subsequent modifications, nor do they represent that the drawings cover all areas of demolition required in the Contract Documents. Furthermore, the Owner and Engineer assume no responsibility for any variation between conditions and obstructions encountered during construction and those indicated on these drawings.
- D. If these drawings contain a stamp indicating that they are record drawings, they are accurate only to the extent of information provided to the Owner by the original contractor.
- E. Additional Investigation: The Contractor shall visit the site and become acquainted with the physical conditions in or relating to existing surface and subsurface structures at or contiguous to the site. Prior to bidding, prospective Contractors may make their own site and subsurface investigations to satisfy themselves with site and subsurface conditions. The Contractor shall be responsible for obtaining rights of ingress and egress to property for site and subsurface investigation and shall assume all responsibility for any damage to property caused as a result of the Contractor's investigation.

END OF SECTION



Part 1 - General

1.01 General Provisions

- A. Demolition work shall be included in the Contract.
- B. Prior to demolition of structures the following procedures shall be accomplished.
 - 1. Owner release of such structure.
 - 2. All electrical and mechanical services rerouted or shut off outside the area of demolition.
 - 3. Coordinate sequencing with Subcontractors.
 - 4. Survey and record the condition of existing facilities to remain in place that may be affected by the demolition operations. After demolition operations are completed, survey the conditions again and restore existing facilities to the pre-demolition condition, at no additional cost to the Owner.
- C. Demolition work shall include all items indicated on the Drawings.

1.02 Schedule

- A. Perform demolition and removal work at such a time and in such a manner, so as not to interfere with the Owner's operations, the work of other trades and other Contracts. Follow the Progress Schedule as agreed to and worked out with the Owner.
- B. Coordinate demolition and removal work with the work of other Contractors, so that the new construction work installed before, during and after the work of this Section may commence without undue delay.

1.03 Protection

- A. Do not close or obstruct streets, walks, and other facilities occupied and used by the Owner and the public, without prior written permission from the Owner and local authorities having jurisdiction.
- B. The structural stability of structures adjacent to, or affected by the work of this Contract will be the responsibility of the Contractor. Provide temporary shoring, and bracing where required.
- C. Provide all necessary shielding of existing materials and equipment, which are to remain, within or adjacent to work areas.
- D. Maintain in service and protect from damage the existing utilities that are indicated to remain.

1.04 Utilities

Notify all utilities in sufficient time prior to razing operations to permit them to disconnect and remove and/or relocate the respective utility.

1.05 Sewer Sealing

Plug and seal, using concrete, piping as shown on the drawings or as directed by the Engineer.

1.06 Salvageable Materials

- A. The Owner shall have first right to salvage material.
- B. Salvage material and equipment to be retained by the Owner shall be located as directed by the Engineer.

1.07 Demolition Operations

- A. Demolition of existing structures shall be conducted to one of the following standards:
 - 1. As shown on the Contract Drawings, or if not detailed on the Contract Drawings,
 - 2. Removed to a minimum of 36 inches below the finished grade, or
 - 3. Removed to 36 inches below the location of a new structure.
- B. Remove existing concrete using an abrasive saw to make initial cuts not less than 2 inches deep, between areas to be removed and areas to remain, providing a smooth, straight joint or cut line. Make cut lines in floor slabs parallel with walls.
- C. If existing abandoned utility lines extend into the area of construction being removed, remove abandoned lines to elevations shown on the drawings, or as directed by the Engineer outside of demolition area and plug permanently with steel cap or concrete.
- D. Adequate drainage of all structures demolished shall be provided by providing openings in the floors and walls of the portion of the structures remaining in place. The Contractor shall notify the Engineer, prior to backfilling the structures remaining in place, in order for him to inspect the drainage provision provided.
- E. Provide all temporary shoring and bracing as required to transfer loads of existing construction to remain from construction being removed. Remove and dispose of temporary support measures when new construction has been installed by other contractors.

END OF SECTION

Part 1 General

1.01 Scope

The work in this Section consists of furnishing all material and equipment and performing all labor necessary for demolishing and disposing of designated facilities indicated on the Drawings.

1.02 Submittals

The Contractor shall submit a written request, to include a detailed demolition procedure, to the Owner for approval at least 10 days before demolition is started. The demolition procedure shall include a detailed description of the methods and equipment to be used for each operation and the sequence of work. The demolition procedures shall provide for safe conduct of work, protection of the property, which is to remain undisturbed and coordination with other work or operation which may be in progress.

Part 2 Products (Not Used)

Part 3 Execution

3.01 Demolition

- A. All material shall be removed as necessary for construction, or in any event, to a minimum depth of three feet below finished grades as shown on the Drawings.
- B. Any structure, or part thereof, remaining below grade shall be mechanically fractured so that subsurface water will freely pass through the slab or floor of the structure, and so that no void will remain after backfilling the work site to grade as shown on the Drawings.
- C. The Contractor shall be responsible for removing all existing service connections to the buildings or site and permanently plugging the pipes where required in accordance with requirements of the utility companies concerned.
- D. The Contractor will be responsible for any damage caused to other structures, and shall be held liable for any and all repairs, replacement of parts or renovations required to restore any structure, portion of structure, equipment or items, not intended for demolition. The Contractor shall restore any damaged facilities to their condition prior to demolition provided the damage was result of the demolition. If the Contractor does not repair any such damage immediately, or if the repairs are not suitable to the Owner, the Owner reserves the right to have such repairs made by another party and deduct the cost of required repairs from money due Contractor.
- E. Dust-tight, weathertight partitions shall be erected to protect existing facilities from dust and weather while wrecking is in progress and until such time as closures have

Demolition of Existing Facilities

been made. Partitions may be constructed of wood and shall have a covering of tarred roofing felt on the weather side.

- F. All salvageable metal materials shall remain the property of the Owner and shall be cleaned and stored on the Owner's property as directed by the Owner.

3.02 Disposal

- A. All materials, which are not delivered to the Owner as specified above, shall become the property of the Contractor, and shall be demolished, moved or otherwise disposed of at the option of the Contractor by a method approved by the Owner.
- B. All demolished structures, equipment and materials shall be removed from the work site by the Contractor.
- C. All demolished structures, equipment and materials which are either left in place or removed to the disposal site shall be in a non-hazardous condition.
- D. Manhole frames and covers to be removed are the property of the Owner and shall be delivered to a place designated by the Owner.

END OF SECTION

Removal of Existing Equipment and Piping

Part 1 General

1.01 Scope

- A. The work covered under this Section includes furnishing all labor, equipment and material required to remove, handle, store and dispose of all materials from existing structures and piping as shown on the Drawings, directed by the Engineer or required for the completion of the work, including all necessary excavation and backfilling.
- B. The Contractor shall remove from existing structures and store as directed or dispose of in an approved manner, all valves and piping, mechanical equipment, plumbing, heating, electrical and ventilating fixtures, pipes, ducts, wires and equipment, doors and windows, floor grating and cover plates, steel stairs, pipe railing and the like which are not to remain in service in the finished work, whether or not shown on the Drawings and/or specified herein.
- C. The work specified herein and shown on the Drawings is intended to give a general idea of the scope of this work but must not be construed as covering it entirely. The Contractor shall visit the site and judge the amount of work required and the problems Contractor might encounter in the performance of the work.

1.02 Equipment And Piping To Be Removed

- A. The existing equipment and piping to be removed and disposed of shall include, but not be limited to, that shown on the Drawings to be removed.

Part 2 Products

2.01 Materials

All concrete, mortar, grout, steel reinforcement and backfill used in patching, plugging or repairing shall comply in all respects with the applicable material requirements of these Specifications.

Part 3 Execution

3.01 Removal

- A. The Contractor shall exercise full care and shall use such methods and equipment during removal as will maintain the usefulness of the various materials and equipment removed. The sequence and order of removal and the method of storing and disposal of removed equipment and piping shall be at all times subject to the direction and approval of the Engineer.

Removal of Existing Equipment and Piping

- B. Any damage done to structures or equipment during removal and any patching, plugging of holes or repairs necessitated because of removal of equipment and piping shall be repaired as directed by, and to the satisfaction of, the Engineer and the cost thereof shall be included in the Contract Price.
- C. Equipment specified to be removed shall be removed completely, including all related accessories and concrete bases. Any embedded items such as anchor bolts, steel reinforcement, conduit and piping shall be cut off 1-inch below adjacent finished surfaces. The surface shall then be repaired to match adjacent surfaces in finish and appearance.
- D. Prior to removing any electrical equipment, all power to the equipment shall be shut off and properly locked out. All power and control wiring for the equipment shall then be disconnected at the starter or circuit breaker, as applicable, and removed from the conduit. Unused conduits shall be plugged.
- E. Blemishes or unsightly areas on walls and floors left after removal of equipment shall be cleaned and refinished as necessary to match adjacent surfaces.
- F. All holes and openings left after removal of equipment shall be filled or plugged to provide a neat and workmanlike appearance.
- G. Where piping designated for removal passes through concrete walls, the openings shall be suitably plugged or capped. Wall pipes and wall sleeves shall be sealed with blind flanges or mechanical joint plugs. Steel pipe sleeves shall be filled with nonshrink grout.
- H. Where equipment or piping designated for removal serves to support other equipment or piping designated to remain in service, the Contractor shall provide permanent supports in place of the removed equipment and piping. Where it is necessary to temporarily remove other equipment, piping or electrical work in order to gain access to an item of equipment or piping designated for removal, the Contractor shall restore all such equipment, piping or electrical work to its original condition.
- I. Abandoned Piping: Existing vitrified clay, concrete, PVC, cast iron and steel piping to be abandoned shall be cut and plugged or capped at each end. Where existing piping interferes with new piping or construction, it shall be removed beyond the limits required for the proper completion of the work and the open ends plugged or capped. Unless otherwise shown, lines shall be plugged or capped at least 1-inch behind or below finished building surfaces and at least 12-inches below outside grade surfaces.
- J. Piping and Valving Reinstallation: The Contractor shall include in the Contract Price the cost of removing, refitting, and reinstalling certain pipe, fittings and valves as shown on the Drawings or as deemed by the Engineer to be satisfactory for reuse.
- K. Removal of Existing Concrete and Masonry: Existing concrete and masonry shall be removed and disposed of in accordance with the requirements of Section 02075 of these Specifications.

Removal of Existing Equipment and Piping

- L. Storage: All materials removed shall remain the property of the Owner and shall be carefully moved and stored on the plant site where directed by the Engineer. Mechanical and electrical equipment shall be stored indoors. If the equipment is too large to store indoors, it shall be stored outdoors above ground and under cover.

- M. Disposal: The Engineer will direct the Contractor to assume ownership of and dispose of off site any removed equipment, piping and materials which the Engineer deems worthless. The cost of disposing of any or all of the removed equipment, piping and materials shall be included in the lump sum prices bid and no separate payment will be made therefore.

END OF SECTION



Part 1 General

1.01 Scope

- A. This Section includes earthwork and related operations, including, but not limited to, clearing and grubbing the construction site, dewatering, excavating all classes of material encountered, pumping, draining and handling of water encountered in the excavations, handling, storage, transportation and disposal of all excavated and unsuitable material, construction of fills and embankments, backfilling around structures and pipe, backfilling all trenches and pits, compacting, all sheeting, shoring and bracing, preparation of subgrades, surfacing and grading, and any other similar, incidental, or appurtenant earthwork operations which may be necessary to properly complete the work.
- B. The Contractor shall provide all services, labor, materials, and equipment required for all earthwork and related operations, necessary or convenient to the Contractor, for furnishing complete work as shown on the Drawings or specified in these Contract Documents.

1.02 General

- A. The elevations shown on the Drawings as existing are taken from the best existing data and are intended to give reasonably accurate information about the existing elevations. They are not precise and the Contractor shall become satisfied as to the exact quantities of excavation and fill required.
- B. Earthwork operations shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards.
- C. All excavated and filled areas for structures, trenches, fills, topsoil areas, embankments, and channels shall be maintained by the Contractor in good condition at all times until final acceptance by the Owner. All damage caused by erosion or other construction operations shall be repaired by the Contractor using material of the same type as the damaged material.
- D. The Contractor shall control grading in a manner to prevent surface water from running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm water can be uninterrupted in existing gutters, other surface drains, or temporary drains. Free access must be provided to all fire hydrants, watergates, and meters.
- E. Excavation work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the work, regardless of the type, character, composition, or condition of the material.

- F. Tests for compaction and density shall be conducted by the Engineer or by an independent testing laboratory selected in accordance with Section 01410 of these Specifications.
1. The soils testing laboratory is responsible for the following:
 - a. Field compaction testing shall be based on using the maximum dry density determined by the Standard Proctor Compaction Test in accordance with ASTM D 698.
 - b. Field compaction testing shall be based on using the maximum dry density determined by the Modified Proctor Compaction Test in accordance with ASTM D 1557.
 - c. Maximum dry density for non-cohesive materials shall mean the maximum index density as determined by the "Maximum Index Density of Soils Using a Vibratory Table", ASTM D 4253.
 - d. Determination of in-place backfill density shall be done in accordance with ASTM D 1556, "Density of Soil In Place by the Sand Core Method", ASTM D 2937, "Density of Soil In Place by the Drive-Cylinder Method" or ASTM D 2922, "Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)".
 - e. Inspecting and testing stripped site, subgrades and proposed fill materials.
 2. Contractor's duties relative to testing include:
 - a. Notifying laboratory of conditions requiring testing.
 - b. Coordinating with laboratory for field testing.
 - c. Providing representative fill soil samples to the laboratory for test purposes. Provide 50 pound samples of each fill soil.
 3. Inspection
 - a. Earthwork operations, suitability of excavated materials for fill and backfill, and placing and compaction of fill and backfill is subject to inspection. Engineer will observe earthwork operations.
 - b. Foundations and shallow spread footing foundations are required to be inspected by a geotechnical engineer to verify suitable bearing and construction.
- G. All earthwork operations shall comply with the requirements of OSHA Construction Standards, Part 1926, Subpart P, Excavations, Trenching, and Shoring, and Subpart O, Motor Vehicles, Mechanized Equipment, and Marine Operations, and shall

be conducted in a manner acceptable to the Engineer.

- H. It is understood and agreed that the Contractor has made a thorough investigation of the surface and subsurface conditions of the site and any special construction problems which might arise as a result of nearby watercourses and floodplains, particularly in areas where construction activities may encounter water-bearing sands and gravels, or limestone solution channels. The Contractor shall be responsible for providing all services, labor, equipment, and materials necessary or convenient to the Contractor for completing the work within the time specified in these Contract Documents.

Part 2 Products

2.01 Materials And Construction

A. Earthwork Materials

1. Fill Material, General
 - a. Approval Required: All fill material shall be subject to the approval of the Engineer.
 - b. Notification: For approval of imported fill material, notify the Engineer and testing laboratory at least one week in advance of intention to import material, designate the proposed borrow area, and permit testing as necessary to prove the quality of the material.
2. On-Site Fill Material
 - a. All on-site fill material shall be soil exclusive of organic matter, frozen lumps, or other deleterious substances.
 - b. It shall contain no rocks or lumps over 3-inches maximum in dimension.
3. Imported Fill Materials: All imported fill material shall meet the requirements of on-site fill material.
4. Sand Cushions and Sand Fill: Sand cushions and sand fill shall consist of a sand-gravel fill of such gradation that 100 percent will pass a 3/8-inch sieve and not more than 10 percent by weight is lost by washing.
5. Coarse Aggregate or Crushed Stone: Coarse aggregate shall have the following gradation:

Sieve Size	% Passing
2-inch	-
1-1/2-inch	100

Sieve Size	% Passing
1-inch	95 - 100
1/2-inch	25 - 60
No. 4	0 - 10
No. 8	0 - 5

6. Fine Aggregate: All fine aggregate shall have the following gradation:

Sieve Size	% Passing
No. 4	100
No. 16	25 - 75
No. 100	0 - 25

Sieve Size	% Passing
No. 8	80 - 100
No. 50	5 - 30
No. 100	0 - 10

7. Pea Gravel: Pea gravel shall be clean, naturally rounded aggregate, 1/8 to 3/4-inch in diameter per ASTM C 33.
8. Top Soil: Dark organic weed free loam, free of muck.

- B. Sheeting, Bracing and Timbering: The Contractor shall furnish, place and maintain all sheeting, bracing and timbering required to properly support trenches and other excavations in open cut and to prevent all movement of the soil, pavement, structures, or utilities outside of the trench or pit.

1. General

- a. Sheeting, bracing and timbering shall be so placed as to allow the work to be constructed to the lines and grades shown on the Drawings and as ordered by the Engineer.
- b. If at any time the method being used by the Contractor for supporting any material or structure in or adjacent to any excavation is not reasonably safe, the Contractor shall provide additional bracing and support necessary to furnish the added degree of safety.
- c. All sheeting in contact with the concrete or masonry shall be cut off as directed by the Engineer and left in place.

2. Timber: Timber may be substituted for steel sheet piling when approved by the Engineer. Timber for shoring, sheeting or bracing shall be sound and free of large or loose knots, and in good condition. Size and spacing shall be in accordance with OSHA regulations.
 3. Steel Sheet Piling: Steel sheet piling shall be the continuous interlock type. The weight, depth, and section modulus of the sheet piling shall be sufficient to restrain the loads of earth pressure and surcharge from existing foundations and/or live loads. Procedure for installation and bracing shall be so scheduled and coordinated with the removal of the earth that the ground under existing structures shall be protected against lateral movement at all times. The Contractor shall provide closure and sealing between sheet piling and existing facilities. Steel piling within three feet of an existing building, structure or pipeline shall remain in place, unless otherwise directed by the Engineer.
 4. Remove bracing and sheeting in units when backfill reaches the point necessary to protect the structures and adjacent property. Leave sheeting in place when, in the opinion of the Engineer, it cannot be safely removed. Cut off sheeting left in place at least two feet below the surface.
- C. Other Materials: All other materials, not specifically described but required for proper completion of the work of this Section, shall be as selected by the Contractor subject to the approval of the Engineer.
- D. Stockpile Area: The stockpile area shown on the Drawings shall be used to stockpile soil material for backfilling around structures and to stockpile needed topsoil.

Part 3 Execution

3.01 General

- A. Safety: Comply with local regulations and with the provisions of the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc., Occupational Safety and Health Act and all other applicable safety regulations.
- B. Topsoil
1. Remove all topsoil to a depth at which subsoil is encountered, from all areas under buildings, pavements, and from all areas which are to be cut to lower grades or filled.
 2. With the Engineer's approval, topsoil to be used for finish grading may be stored on the site.
 3. Other topsoil may be used for fill in non-critical areas with approval of the Engineer.

4. Properly dispose of all excess topsoil off site.

C. Bracing and Sheeting

1. Furnish, put in place, and maintain all sheeting, bracing, and shoring as may be required to properly support the sides of all excavations and to prevent all movement of earth which could in any way injure the work, adjacent property or workers.
2. Properly support all excavations in locations indicated on the Drawings and where necessary to conform to all pertinent rules and regulations and these Specifications, even though, such locations are not indicated on the Drawings.
3. Exercise care in the removal of sheeting, shoring, bracing and timbering to prevent collapse or caving of the excavation faces being supported and damage to the work and adjacent property.
4. Do not leave any sheeting or bracing in the trench or excavation after completion of the work, unless approved by the Engineer.

D. Obstructions

1. Remove and dispose of all trees, stumps, roots, boulders, sidewalks, driveways, pavement, pipes, and the like, as required for the performance of the work.
2. Exercise care in excavating around catch basins, inlets and manholes so as to not disturb or damage these structures.
3. Avoid removing or loosening castings or pushing dirt into catch basins, inlets and manholes.
4. Damaged or displaced structures or casting shall be repaired, replaced and dirt entering the structures during the performance of the work shall be removed at no additional cost to the Owner.

E. Utilities to be Abandoned

1. When pipes, conduits, sewers, or other structures are removed from the trench, leaving dead ends in the ground, such ends shall be fully plugged or sealed with brick and non-shrink grout.
2. Abandoned structures such as manholes or chambers shall be entirely removed unless otherwise specified or indicated on the Drawings.
3. All materials from abandoned utilities which can be readily salvaged shall be removed from the excavation and stored on the site at a location as directed by the Owner.
4. All salvageable materials will remain the property of the Owner unless otherwise indicated by the Owner.

F. Extra Earth Excavation

1. In case soft or excessively wet material which, in the opinion of the Engineer, is not suitable, is encountered below the final subgrade elevation of an excavation or underneath a structure, the Engineer may order the removal of this material and its replacement with crushed stone or other suitable material in order to make a suitable foundation for the construction of the structure.

G. Cutting Paved Surfaces and Similar Improvements

1. Remove existing pavement as necessary for installing pipe utilities and appurtenances or as otherwise shown on the Drawings.
2. Before removing any pavement, mark the pavement neatly, paralleling pipe lines and existing street lines. Space the marks the width of the trench.
3. Break asphalt pavement along the marks using jack hammers or other suitable tools. Break concrete pavement along the marks by use of jack hammers or by scoring with a rotary saw and breaking below the score by the use of jack hammers or other suitable tools.
4. Do not pull pavement with machines until completely broken and separated from pavement to remain.
5. Do not disturb or damage the adjacent pavement. If the adjacent pavement is disturbed or damaged, remove and replace the damaged pavement. No additional payment will be made for removing and replacing damaged adjacent pavement.
6. Remove and replace sidewalks disturbed by construction for their full width and to the nearest undisturbed joint.
7. The Contractor may tunnel under curbs that are encountered. Remove and replace any curb disturbed by construction to the nearest undisturbed joint.

3.02 Excavation

A. Method

1. All excavation shall be by open cut from the surface except as indicated on the Drawings.
2. All excavations for pipe appurtenances and structures shall be made in such a manner, and to such depth and width, as will give ample room for building the structures, and for bracing, sheeting, and supporting the sides of the excavation, for pumping and draining groundwater which may be encountered, and for the removal from the excavation of all materials excavated.

3. Take special care so that the soil below the bottom of the structure to be built is left undisturbed.
- B. Grades: Excavate to grades indicated on the Drawings. Where excavation grades are not indicated on the Drawings, excavate as required to accommodate installation.
- C. Disposal of Excavated Material
1. Remove and properly dispose of all excavated material not needed to complete filling, backfilling and grading.
 2. Dispose of excess excavated material at locations on-site designated by the Engineer and in accordance with all requirements of federal, state, county, and municipal regulations. No debris of any kind shall be deposited in any stream or body of water, or on any street or alley. No debris shall be deposited on any private property, except by written consent of the property owner. In no case shall any material be shoved onto abutting private properties, or be buried in embankments or trenches on the Project.

3.03 Excavating For Structures

- A. Earth Excavation: Earth excavation shall include all substances to be excavated other than rock. Earth excavation for structures shall be to limits not less than two feet outside wall lines, to allow for formwork and inspection, and further as necessary to permit the trades to install their work. All materials loosened or disturbed by excavation shall be removed from surfaces to receive concrete or crushed stone.
- B. Rock Excavation
1. Definition of Rock: Any material which cannot be excavated with a single-tooth ripper drawn by a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds (comparable to Caterpillar D 8K or Caterpillar 977 front-end loader, and occupying an original volume of at least one cubic yard). The Engineer shall be the sole determinant as to the limits the material is classified as rock.
 2. Excavation: Where rock is encountered within excavation for structures, it shall be excavated to the lines and grades indicated on the Drawings, or as otherwise directed by the Engineer. The Contractor shall be responsible for obtaining any blasting permits required.
 3. Blasting: Blasting operations shall be conducted in accordance with all existing ordinances and regulations. All structures shall be protected from the effects of the blast. The blasting shall be done by licensed experienced workers. Dispose of excavated rock in accordance with applicable federal, state, county, and local regulations.

- a. If, in the sole opinion of the Engineer, the Contractor persistently uses excessive blasting charges or blasts in an unsafe or improper manner, the Engineer will direct the Contractor to employ an independent, qualified blasting consultant, approved by the Engineer, to supervise the preparation for each blast and approve the quantity of each charge.
 - b. The Contractor will notify the Inspector before any charge is set and prior to blasting. Following review by the Inspector regarding the proximity (normally within 300 linear feet) of permanent structures to the blasting site, the Engineer may direct the Contractor to employ an independent qualified specialty subcontractor, approved by the Engineer, to monitor the blasting by use of seismograph, identify areas where light charges must be used, conduct pre-event and post-event inspections of all structures, including photographs or videos, and maintain a detailed written log.
 - c. Any damage caused as a result of blasting operations shall be promptly repaired by the Contractor at the Contractor's own expense.
4. No allowance shall be made for overcutting or for excavation below the required elevations. The Engineer must be given reasonable notice to measure all rock.
 5. If excess excavation is made or the material becomes disturbed so as to require removal below final subgrade elevations or beyond the prescribed limits, the resulting space shall be refilled with Class "C" concrete in accordance with Section 03300 of these Specifications.
- C. Excavation for Foundations: Footings and slabs on grades shall rest on undisturbed earth, rock or compacted materials to insure proper bearing.
1. Unsuitable Foundation Material: Any material, in the opinion of the Engineer, which is unsuitable for foundation shall be removed and replaced with compacted crushed stone, or with compacted fill material as directed by the Engineer. No determination of unsuitability will be made until all requirements for dewatering are satisfactorily met.
 2. Foundation in Rock: Foundations for a structure shall be on similar materials. Should excavation for a foundation be partially in rock, the Contractor shall undercut that portion of the rock 12-inches and bring the excavation to grade with compacted crushed stone.
 3. Pipe Trenches Beneath Structures: Where piping or conduit passes beneath footings or slabs resting on grade, trenches shall be excavated to provide a minimum 6-inch clearance from all surfaces of the pipe or conduit. The trench shall be backfilled to the base of the structure with [crushed stone].
 4. Unauthorized Excavation: Care shall be taken that excavation does not extend below bottom levels of footings or slabs on earth or rock. Should the excavation, through carelessness or neglect, be carried below such levels, the

Contractor shall fill in the resulting excess excavation with concrete under footings and compacted crushed stone or other approved material under slabs.

Should excavation be carried beyond outside lines of footings such excess excavation shall be filled with concrete, or formwork shall be provided, as directed by the Engineer.

D. Unsuitable Bearing

1. If suitable bearings for foundations are not encountered at the elevations indicated on the Drawings, immediately notify the Engineer.
2. Do not proceed further until instructions are received and necessary measurements made for purposes of establishing additional volume of excavation.

3.04 Compaction

- A. Fill materials supporting roadways, parking areas, sidewalks, structures, and buildings and backfill around structures shall be compacted to 95 percent of the maximum dry density. The top 12-inches of fill materials supporting structures or pavement shall be compacted to 98 percent of the maximum dry density. Fill placed for general site grading shall be compacted to 90 percent of the maximum dry density.
- B. Compaction of embankments shall be by sheepsfoot rollers with staggered, uniformly spaced knobs and suitable cleaning devices. The projected area of each knob and the number and spacing of the knobs shall be such that the total weight of the roller and ballast when distributed over the area of one row of knobs shall be 250 psi. Placement and compaction of materials shall extend beyond the final contours sufficiently to insure compaction of the material at the resulting final surface. Final contours shall then be achieved by a tracked bulldozer shaping the face of the embankment.
- C. Compaction of backfill around structures shall be accomplished by heavy power tamping equipment.
- D. If tests indicate that density of fill is less than that specified, the area shall be either recompacted or undercut, filled, and compacted until specified density is achieved.

3.05 Fill

A. Controlled Fill

1. The fill for roadways, parking areas, walks, structures, and building slabs on grade shall be controlled fill.
2. After the existing ground or excavated area has been proofrolled and examined by the Engineer, all holes and other irregularities shall be filled and compacted before the main fill is placed.

3. The fill shall be placed in even layers not exceeding 10-inches in depth and shall be thoroughly compacted as herein specified.
4. If an analysis of the soil being placed shows a marked difference from one location to another, the fill being placed shall not be made up of a mixture of these materials.
5. Each different type of material shall be handled continuously so that field control of moisture and density may be based upon a known type of material.
6. No fill shall be placed following a heavy rain without first making certain on isolated test areas that compaction can be obtained without damage to the already compacted fill.

B. Proofrolling

1. All areas where roadways, parking areas, sidewalks, structures, and buildings are to be constructed on cut areas, compacted fill, and other areas where indicated on the Drawings, shall be proofrolled to detect soft spots prior to the placement of fill material and placement of fill, which shall be construction of foundations.
2. Proofrolling shall consist of having a 10 ton vibratory roller over the subgrade before the subgrade is shaped.
3. Proofrolling shall be witnessed by the Engineer.
4. Subgrade shall be proofrolled with six passes of the truck or roller. Depressions that develop during the proofrolling operation shall be filled with suitable material and those filled areas shall be proofrolled with six passes of the roller. If, after having been filled and proofrolled, the subgrade still contains depressions, the area shall be undercut to the full depth of the soft material or five feet, whichever is less, backfilled, recompact, and rolled to achieve a subgrade acceptable to the Engineer.
5. After the proofrolled subgrade has been accepted by the Engineer, the surface of the subgrade shall be finish rolled with a smooth steel wheel roller weighing not less than 10 tons. Finished surface of the subgrade shall be within a tolerance of 1/4-inch at every point.
6. Conduits, pipes, culverts, and underdrains shall be neither disturbed nor damaged by proofrolling operations. Rollers shall neither pass over, nor approach closer than five feet to, conduits, pipes, culverts, and underdrains unless the tops of those products are deeper than three feet.

C. Placement

1. Prior to placement of any material in embankments, the area within embankment limits shall be stripped of topsoil and all unsuitable materials removed in accordance with this Section. The area shall then be scarified to a

depth of at least 6-inches.

2. Fill materials shall be placed in continuous, approximately horizontal layers extending the full width of the embankment cross-section and the full dimension of the excavation where practical and having a net compacted thickness of not over 6-inches.
- D. Final Grading: Upon completion of construction operations, the area shall be graded to finish contour elevations and grades shown on the Drawings. Graded areas shall be made to blend into conformation with remaining ground surfaces. All surfaces shall be left smooth and free to drain.
- E. Excess Material: Surfaces and slopes of waste fills shall be left smooth and free to drain.
- F. Moisture
1. Fill materials shall be placed at optimum moisture content within practicable limits, but not less or more than twopercent of optimum. Optimum moisture shall be maintained by sprinkling the layers as placed or by allowing materials to dry before placement.
 2. If fill material is too wet, provide and operate approved means to assist the drying of the fill until suitable for compaction.
 3. If fill material is too dry, provide and operate approved means to add moisture to the fill layers.

3.06 Backfilling

- A. Backfill carefully to restore the ground surface to its original condition. Dispose of excess material in accordance with this Section.
- B. Compact backfill underlying roadways, parking areas, sidewalks, structures and buildings in accordance with the requirements of Article 3.04 of this Section.
- C. Backfilling Around Structures
1. General
 - a. Remove debris from excavations before backfilling.
 - b. Do not backfill against foundation walls until so directed by the Engineer nor until all indicated perimeter insulation and/or waterproofing is in place.
 - c. Protect such insulation and/or waterproofing during filling operations.
 - d. Wherever possible, backfilling shall be simultaneous on both sides of walls to equalize lateral pressures.

- e. Do not backfill against walls until all permanent construction is in place to furnish lateral support on both top and bottom of wall.
 - f. Backfilling against walls shall take place after all the concrete in the affected members has attained the specified strengths.
2. Materials: Backfill material placed against structures built or encountered during the work of this Section shall be suitable fill material. No broken concrete, bricks or similar materials will be permitted as backfill.

3.07 Grading

- A. General: Perform all rough and finish grading required to attain the elevations indicated on the Drawings. Perform finish grading to an accuracy of ± 0.10 foot.
- B. Compact backfill underlying roadways, parking areas, sidewalks, structures and buildings in accordance with Article 3.04 of this Section.
- C. Backfilling Around Structures
 - 1. General
 - a. Remove debris from excavations before backfilling.
 - b. Do not backfill against foundation walls until so directed by the Engineer nor until all indicated perimeter insulation and/or waterproofing is in place.
 - c. Protect such insulation and/or waterproofing during filling operations.
 - d. Wherever possible, backfilling shall be simultaneous on both sides of walls to equalize lateral pressures.
 - e. Do not backfill against walls until all permanent construction is in place to furnish lateral support on both top and bottom of wall.
 - f. Backfilling against walls shall take place after all the concrete in the affected members has attained the specified strengths.
 - 2. Materials: Backfill material placed against structures built or encountered during the work of this Section shall be suitable fill material. No broken concrete, bricks or similar materials will be permitted as backfill.
- D. Treatment After Completion of Grading
 - 1. After grading is completed, permit no further excavation, filling or grading, except with the approval of the Engineer.

2. Use all means necessary to prevent the erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

3.08 Surface Water Control

- A. Regulations and Permits: Obtain all necessary soil erosion control permits in accordance with [pertinent rules, laws, and regulations of all applicable federal, state, county and municipal regulatory agencies.
- B. Unfavorable Weather: Do not place, spread or roll any fill material during unfavorable weather conditions. Do not resume operations until moisture content and fill density are satisfactory to the Engineer.
- C. Provide berms or channels to prevent flooding of subgrade. Promptly remove all water collected in depressions.
- D. Pumping and Drainage
 1. Provide, maintain and use at all times during construction adequate means and devices to promptly remove and dispose of all water from every source entering the excavations or other parts of the work.
 2. Dewater by means which will insure dry excavations, preserve final lines and grades, do not disturb or displace adjacent soil.
 3. All pumping and drainage shall be done with no damage to property or structures and without interference with the rights of the public, owners of private property, pedestrians, vehicular traffic or the work of other contractors, and in accordance with all pertinent laws, ordinances and regulations.
 4. Do not overload or obstruct existing drainage facilities.

3.09 Settlement

- A. The Contractor shall be responsible for all settlement of backfill, fills and embankments which may occur within one year after final acceptance of the Work by the Owner.
- B. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after receipt of written notice from the Engineer or Owner.

3.10 Cleaning

Upon completion of the work of this Section, remove all rubbish, trash, and debris resulting from construction operations. Remove surplus equipment and tools. Leave the site in a neat and orderly condition acceptable to the Engineer, and in conformance with Section [01710] of these Specifications.

END OF SECTION

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Part 1 - General

1.01 Work Included

- A. Remove topsoil and stockpile for later reuse.
- B. Excavate subsoil and stockpile for later reuse as directed in Section 02223, Embankments.
- C. Grade and rough contour site.

1.02 Related Requirements

- A. Section 02222 - Excavation.
- B. Section 02223 - Embankments.
- C. Section 02225 - Excavation, Backfilling and Compacting for Utilities.

1.03 Project Record Documents

Accurately record location of utilities remaining, rerouted utilities, new utilities by horizontal dimensions, elevations or inverts, and slope gradients.

1.04 Protection

- A. Protect trees and other features remaining as portion of final landscaping.
- B. Protect bench marks, existing structures, fences, roads, sidewalks and other features not designated for demolition.
- C. Protect above or below grade utilities which are to remain.
- D. Contractor shall be responsible for repairing any damage to those items not designated for demolition or removal in a manner satisfactory to the Owner at no additional cost to the Owner.

Part 2 – Products

2.01 Materials

- A. Topsoil: Excavated material, graded free of roots, rocks larger than 1 inch, subsoil, debris, and large weeds.
- B. Subsoil: Excavated material, graded free of lumps larger than 12 inches, rocks larger than 12 inches, and debris.

Part 3 - Execution

3.01 Preparation

- A. Identify required lines, levels, contours, and datum.
- B. Identify known below grade utilities. Stake and flag locations.
- C. Identify and flag above grade utilities.
- D. Maintain and protect existing utilities remaining which pass through work area.
- E. Upon discovery of unknown utility or concealed conditions, discontinue affected work; notify Engineer.

3.02 Topsoil Excavation

- A. Excavate topsoil from areas to be further excavated, and stockpile in area designated on site by the Engineer.
- B. Do not excavate wet topsoil.
- C. Stockpile topsoil to depth not exceeding 8 feet.

3.03 Subsoil Excavation

- A. Excavate subsoil from indicated areas and stockpile in area designated on site. Excess subsoil may be reused in accordance with Section 02223, Embankments.
- B. Do not excavate wet subsoil.
- C. Stockpile subsoil to depth not exceeding 8 feet.
- D. When excavation through roots is necessary, perform work by hand and cut roots with a sharp axe.

3.02 Tolerances

Top Surface of Subgrade: Plus or minus 3 inches.

END OF SECTION

Part 1 – General

1.01 Work Included

Structure excavation.

1.02 Related Requirements

- A. Section 02223 - Embankments.
- B. Section 02225 - Excavating, Backfilling and Compacting for Utilities.

1.03 Protection

- A. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation.
- B. Underpin adjacent structures which may be damaged by excavation work, including service utilities and pipe chases.
- C. Notify Engineer of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.
- D. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.
- E. Grade excavation top perimeter to prevent surface water run-off into excavation.
- F. Contractor shall provide ample means and devices with which to intercept any water entering the excavation area.

1.04 Rock Excavation

Any rock encountered within foundation excavations for recommended soil bearing elements should be removed to a depth sufficient to provide a minimum 24 inch soil cushion between the bottom of the footing and the top of rock. The soil cushion should be constructed of properly compacted on-site soils free of organics and deleterious materials. See Section 02223, Embankments.

Part 2 – Products

2.01 Materials

- A. Subsoil: Excavated material, graded free of lumps larger than 12 inches, rocks larger than 12 inches, and debris.

Excavation

- B. Pea Gravel: Mineral aggregate graded 1/4 inch to 5/8 inch, free of soil, subsoil, clay, shale, or foreign matter.

Part 3 - Execution

3.01 Preparation

Identify required lines, levels, contours, and datum.

3.02 Excavation

- A. Excavate subsoil required for structure foundations, construction operations, and other work.
- B. Contractor is responsible to adequately brace open cuts and protect workmen and equipment from cave-in.
- C. Remove lumped subsoil, boulders, and rock up to 1/3 cu. yd., measured by volume.
- D. Correct unauthorized excavation at no cost to Owner.
- E. Fill over-excavated areas under structure bearing surfaces in accordance with direction by Engineer.
- F. Stockpile excavated material in area designated on site.

3.03 Excavation for Structures

- A. For structures, excavate to elevations and dimensions indicated, plus ample space for construction operations and inspection of foundations.
 - 1. Excavate for foundation bearing a minimum of 24 inches below existing grade. Structure foundations shall bear entirely in original subsoil, entirely on rock, or entirely on compacted earth or granular fill. Where structures are not to be supported on rock and rock is encountered, undercut rock 18 inches and backfill with compacted earth or granular material.
 - 2. Prior to placement of any granular fill, forms, reinforcing steel, or concrete, schedule and provide site visit services by the same firm which provided geotechnical investigations utilized in the structural design of the foundations for the project, as per Section 01400, Quality Control. Said visits shall be for the sole purpose of confirming that the conditions described in the geotechnical report are present over the foundation areas extending beyond the investigational borings.
 - 3. If material unsuitable for foundation (in the opinion of the geotechnical Engineer) is found at or below the grade to which excavation would normally be carried in accordance with the Drawings and/or Specifications, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted, screened gravel, select bank-run gravel, fine aggregate or concrete as directed, in order to provide a suitable bearing for the foundation.

4. Structure foundations shall be installed immediately after excavation is completed, or if this cannot be done, the last 4 to 6 inches of material should not be removed until preparations for installing the foundation are complete. In no case should foundations be installed in excavations which contain water. Any soft, saturated areas in the bottom of excavations shall be removed or stabilized using granular material.
3. Make no excavation to the full depth indicated when freezing temperatures may be expected unless foundations can be installed after the excavation has been completed. Protect the bottom so excavated from frost if foundation installation is delayed.

3.04 Removal of Water

- A. The Contractor, at his own expense, shall provide adequate facilities for promptly and continuously removing water from all excavation.
- B. To ensure proper conditions at all times during construction, the Contractor shall provide and maintain ample means and devices (including spare units kept ready for immediate use in case of breakdowns) with which to remove promptly and dispose properly of all water entering trenches and other excavations. Such excavation shall be kept dry until the structures, pipes, and appurtenances to be built therein have been completed to such extent that they will not be floated or otherwise damaged.
- C. All water pumped or drained from the Work shall be disposed of in a suitable manner without undue interference with other work, damage to pavements, other surfaces, or property. Suitable temporary pipes, flumes, or channels shall be provided for water that may flow along or across the site of the Work.
- D. If necessary, the Contractor shall dewater the excavations by means of an efficient drainage wellpoint system which will drain the soil and prevent saturated soil from flowing into the excavation. The wellpoints shall be designed especially for this type of service. The pumping unit shall be designed for use with the wellpoints, and shall be capable of maintaining a high vacuum and of handling large volumes of air and water at the same time.
- E. The installation of the wellpoints and pump shall be done under the supervision of a competent representative of the manufacturer. The Contractor shall do all special work such as surrounding the wellpoints with sand or gravel or other work which is necessary for the wellpoint system to operate for the successful dewatering of the excavation.

3.05 Unauthorized Excavation

If the bottom of any excavation is taken out beyond the limits indicated or prescribed, the resulting void shall be backfilled at the Contractor's expense with thoroughly compacted earth material in accordance with Section 02223, Embankment, or with 3,500 psi concrete, if the excavation was for a structure.

3.06 Excess Material

- A. No excavated materials shall be removed from the site of the work or disposed of by the Contractor except as directed or permitted.
- B. Surplus excavated materials suitable for backfill shall be used to backfill normal excavations in rock or to replace other materials unacceptable for use as backfill; shall be neatly deposited and graded so as to make or widen fills, flatten side slopes, or fill depressions. All work shall be as directed or permitted and without additional compensation.
- C. Surplus excavated materials not needed as specified above shall be disposed of by the Contractor, who shall obtain all permits and make all arrangements required.

3.07 Existing Utilities and Other Obstructions

Prior to the commencement of construction on the project, the Contractor shall contact the utility companies whose lines, above and below ground, may be affected during construction and verify the locations of the utilities as shown on the Contract Drawings. The Contractor shall ascertain from said companies if he will be allowed to displace or alter, by necessity, those lines encountered or replace those lines disturbed by accident during construction, or if the companies themselves are only permitted by policy to perform such work. If the Contractor is permitted to perform such work, he shall leave the lines in as good condition as were originally encountered and complete the Work as quickly as possible. All such lines or underground structures damaged or molested in the construction shall be replaced at the Contractor's expense, unless in the opinion of the Engineer, such damage was caused through no fault of the Contractor.

3.08 Field Quality Control

Provide for visual inspection of rock surfaces and foundation sub-grades under provisions of Division 1.

END OF SECTION

Part 1 - General

1.01 Work Included

- A. Structure perimeter backfilling to subgrade elevations.
- B. Site backfilling.
- C. Compaction requirements.
- D. Access road subgrade preparation.

1.02 Related Work

- A. Division 1 - Submittals.
- B. Division 1 - Quality Control: Compaction requirements of backfill.
- C. Section 02222 - Excavation.
- D. Section 02225 - Excavation, Backfilling and Compacting for Utilities.

1.03 References

- A. Commonwealth of Kentucky, Standard Specifications for Road and Bridge Construction.
- B. ANSI/ASTM D698 - Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 5.5 lb Rammer and 12 inch Drop.
- C. ANSI/ASTM D1556 - Density of Soil in Place by the Sand-Cone Method.
- D. ASTM 2922 - Density of Soil and Soil-Aggregate in Place by Nuclear Methods.
- E. ASTM 3017 - Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.04 Tests

- A. Tests and analysis of fill materials will be performed in accordance with ANSI/ASTM D698 and under provisions of Section 01400. Tests shall include but not be limited to gradation analysis and moisture/density relationships.
- B. Test will be performed by an approved independent testing laboratory and shall be the responsibility of the Contractor at no additional cost to the Owner.
- C. Density test shall be performed in sufficient number to insure the specified densities are being obtained.

- D. When ASTM D2922 is used, the calibration curves shall be checked and adjusted if necessary by the procedure described in ASTM D2922, paragraph ADJUSTING CALIBRATION CURVE. ASTM D2922 results in a wet unit weight of soil; and when using this method, ASTM D3017 shall be used to determine content of the soil. The calibration checks of both the density and moisture gages shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the testing laboratory.

1.05 Submittals

Results of soil moisture and density tests by an approved testing laboratory shall be submitted to the Engineer for review.

Part 2 - Products

2.01 Select Fill Materials

- A. The on-site residual soils may be suitable for use as compacted fill. Fill that will support foundation elements should be placed in 6- to 8-inch loose lifts and compacted to a minimum of 100 percent of its maximum dry density and within plus or minus 2 percent of optimum moisture content as determined by standard Proctor moisture density test. A minimum of 95 percent of the maximum dry density and plus or minus 2 percent of optimum moisture content should be obtained for fill soils supporting floor slabs, sidewalks or pavements. Field density tests should be performed on each lift placed to determine if proper compaction is being achieved. If sufficient suitable material is not available from the excavations, the backfill material shall be screened gravel, crushed stone or selected borrow as directed.
- B. Frozen material shall not be placed in the backfill nor shall backfill be placed upon frozen material. Previously frozen material shall be removed or shall be otherwise treated as required before new backfill is placed.
- C. All material, whether from the excavations or from borrow, shall be of such nature that after it has been placed and properly compacted, it will make a dense, suitable fill. It shall not contain vegetation, masses of roots, individual roots more than 18 inches long or more than 1/2-inch in diameter, stones over 6 inches in diameter, or porous matter.

2.02 Compacted Fill

- A. Soil used for compacted fill should be inorganic clayey soils free of deleterious debris or rocks whose largest dimension is no greater than 3-inches. The soil should have a liquid limit (LL) of less than 50, a plasticity index (PI) of less than 30, and a maximum dry density according to the standard Proctor compaction test of at least 100 pcf. The fill should be compacted to at least 95 percent of the SPMDD. The top foot of structural fill shall be compacted to 100 percent of the SPMDD.
- B. The moisture content of the compacted fill material shall be within 2% of the optimum moisture content as determined by ASTM D-698.

2.03 Structural Backfill

- A. An underdrain system shall be provided for the soil bearing structures. The underdrain should be constructed of a free draining material and designed in a manner that would promote positive drainage away from the foundation elements. Final site grading should be accomplished in such a manner as to divert surface runoff and roof drains away from all foundation elements.
- B. All structures, unless otherwise noted on the Drawings, shall be supported entirely by well compacted crushed stone consisting of Kentucky No. 610 size aggregate. Any building supported by stone should have a minimum of 12 inches of compacted crushed stone beneath the bottom of the slab (i.e. foundation elements). Structures should not be supported on a combination of crushed stone and bedrock.
- C. Crushed stone used as a bearing medium should be placed in uniform, loose lifts not exceeding 8 inches in thickness. It is recommended that each lift be compacted by a minimum of five (5) passes of a smooth drum vibratory roller having a total static weight of not less than 20,000 pounds. The diameter of the drum should be between 5.0 and 5.5 feet and 6.0 and 6.5 feet wide.
- D. Walls below final grade should be backfilled with a minimum 12-inch thick layer of free draining material up to two feet below final grade. The two feet above this free draining material should be backfilled with an impervious material that would retard surface water infiltration. The free draining material should extend down to a rock blanket beneath the bottom slab.

Part 3 - Execution

3.01 Inspection

- A. Verify foundation perimeter drainage installation has been inspected.
- B. Verify areas to be backfilled are free of debris, snow, ice, or water, and ground surfaces are not frozen.

3.02 Preparation

- A. When necessary, compact subgrade surfaces to density requirements for the backfill material and prepare subgrade or previous layer of compacted fill prior to placement of additional fill by scarifying or disking.
- B. Cut out soft areas of subgrade not readily capable of in situ compaction. Backfill with subsoil and compact to density equal to requirements for subsequent backfill material.

3.03 Backfilling - General

- A. Backfill areas to contours and elevations. Use unfrozen materials. The Contractor shall keep the foundation and subgrade free from water or unacceptable materials after the fill operations have started.
- B. Backfill systematically, as early as possible, to allow maximum time for natural settlement. Do not backfill over porous, wet, or spongy subgrade surfaces.
- C. Place and compact fill materials in continuous layers not exceeding 8 inches loose depth. Field density tests shall be performed on each lift.
- D. Employ a placement method so not to disturb or damage foundation drainage.
- E. Maintain optimum moisture content of backfill material to attain required compaction density as specified. Material deposited on the fill that is too wet shall be removed or spread and permitted to dry, assisted by disking or blading, if necessary, until the moisture content is reduced to the specified limits.
- F. All crushed stone fill and crushed stone backfill under structures and pavements adjacent to structures shall be DGA per crushed stone per Kentucky Highway Department Standard Specifications for Road and Bridge Construction, unless indicated otherwise. Fill and backfill materials shall be placed in layers not exceeding six (6) inches in thickness and compacted to 95 percent of maximum dry density.
- G. Backfill shall not be placed against or on structures until they have attained sufficient strength to support all loads to which subjected without distortion, cracking, or damage. Deposit soil evenly around the structure.
- H. Slope grade away from structures minimum 2 inches in 10 feet, unless noted otherwise.
- I. Make changes in grade gradual. Blend slopes into level areas.
- J. Remove surplus excavation materials to designated areas.

3.04 Tolerances

Top Surface of Backfilling: Plus or minus 1 inch.

3.05 Field Quality Control

- A. Compaction testing will be performed in accordance with ASTM D1556 or ASTM D2922 and under provisions of Division 1.
- B. Tests shall be performed on each 100 square feet of surface area and on each lift of the surface area, where more than one lift is required to achieve the required bearing or backfill surface.

- C. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.

END OF SECTION



Part 1 - General

1.01 Work Included

The Contractor shall make excavations in such widths and depths as will give suitable room for below grade vaults, pump stations, etc., laying pipe to the lines, grades and elevations, furnish, place and compact all backfill materials specified herein or denoted on the Drawings. The materials, equipment, labor, etc., required herein are to be considered as part of the requirements and costs for installing the various pipes, structures and other items they are incidental to.

1.02 Related Work

- A. Section 02731 - Gravity Sewers.
- B. Section 02735 - Manholes and Precast Sewage Structures.

Part 2 - Products

2.01 Materials

- A. Crushed stone material shall conform with the requirements of the applicable sections of the Kentucky Bureau of Highways Standard Specifications and shall consist of clean, hard, and durable particles or fragments, free from dirt, vegetation or objectionable materials.
- B. Two classes of crushed stone material are used in this Section. The type of material in each class is as follows:
 - 1. Class I - No. 9 Aggregate.
 - 2. Class II - Dense Graded Aggregate (DGA).

Part 3 - Execution

3.01 Excavation of Trenches

- A. Unless otherwise directed by the Engineer, trenches are to be excavated in open cuts.
 - 1. Where pipe is to be laid in gravel bedding or concrete cradle, the trench may be excavated by machinery to, or just below, the designated subgrade, provided that the material remaining at the bottom of the trench is no more than slightly disturbed.

2. Where pipe is to be laid directly on the trench bottom, the lower part of trenches in earth shall not be excavated to subgrade by machinery. However, just before the pipe is to be placed, the last of the material to be excavated shall be removed by means of hand tools to form a flat or shaped bottom, true to grade, so that the pipe will have a uniform and continuous bearing and support on firm and undisturbed material between joints except for limited areas where the use of pipe slings may have disturbed the bottom.
- B. Trenches shall be sufficient width to provide working space on each side of the pipe and to permit proper backfilling around the pipe.
 1. The Contractor shall remove only as much of any existing pavement as is necessary for the prosecution of the Work. The pavement shall be cut with pneumatic tools, without extra compensation to the Contractor, to prevent damage to the remaining road surface. Where pavement is removed in large pieces, it shall be disposed of before proceeding with the excavation.
 - C. All excavated materials shall be placed a safe distance back from the edge of the trench.
 - D. Unless specifically directed otherwise by the Engineer, not more than 500 feet of trench shall be opened ahead of the pipe laying work of any one crew, and not more than 500 feet of open ditch shall be left behind the pipe laying work of any one crew. Watchmen or barricades, lanterns and other such signs and signals as may be necessary to warn the public of the dangers in connection with open trenches, excavations and other obstructions, shall be provided by and at the expense of the Contractor.
 - E. When so required, or when directed by the Engineer, only one-half of street crossings and road crossings shall be excavated before placing temporary bridges over the side excavated, for the convenience of the traveling public. All backfilled ditches shall be maintained in such manner that they will offer no hazard to the passage of traffic. The convenience of the traveling public and the property owners abutting the improvements shall be taken into consideration. All public or private drives shall be promptly backfilled or bridged at the direction of the Engineer.
 - F. Trench excavation shall include the removal of earth, rock, or other materials encountered in the excavating to the depth and extent shown or indicated on the Drawings.

3.02 Gravity Sewer and Force Main Pipe Bedding

- A. Piping for gravity sewers and force mains shall be supported as follows:
 1. All gravity sewer piping shall be laid on a bed of granular material except when a concrete encasement situation occurs. All pipe bedding material shall be Class I (No. 9 crushed stone aggregate) and shall be placed to a depth of 4 inches in an earth trench and 6 inches in a rock trench. Aggregate bedding shall be graded to provide for a uniform and continuous support beneath the pipe at all points.
 2. The trench bottom for force main piping shall be stable, continuous, relatively smooth and free of frozen material, clodded dirt, foreign material and rock or

granular material larger than 1/2 inch in diameter. The foundation for force main piping shall be prepared so that the entire load of the backfill on top of the pipe will be carried uniformly on the barrel of the pipe. Any uneven areas in the trench bottom shall be shaved-off or filled-in with Class I granular bedding. When the trench is made through rock, the bottom shall be lowered to provide 6 inches of clearance around the pipe. Class I granular bedding shall be used to bring the trench bottom to grade.

- B. After each pipe has been brought to grade, aligned, and placed in final position, Class I material for gravity sewer piping and earth material for force main piping in areas not subject to vehicular traffic and Class I material for force mains in paved areas, shall be deposited and densified under the pipe haunches and on each side of the pipe up to the spring line of the pipe to prevent lateral displacement and hold the pipe in proper position during subsequent pipe jointing, bedding, and backfilling operations.
- C. In wet, yielding and mucky locations where pipe is in danger of sinking below grade or floating out of grade or line, or where backfill materials are of such a fluid nature that such movements of pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective.
- D. Where an unstable (i.e., water, mud, etc.) trench bottom is encountered, stabilization of the trench bottom is required. This is to be accomplished by undercutting the trench depth and replacing to grade with a foundation of crushed stone aggregate.
- E. The depth of the foundation is dependent upon the severity of the trench bottom. The size of stone aggregate used in the foundation will be determined by the condition of the unstable material. Once the trench bottom has been stabilized, the required Class I bedding material can be placed.
- F. It should be noted that no pipe shall be laid on solid or blasted rock.
- G. Pipe bedding, as required in Paragraphs A, B, C, and D of this Section, is **not** considered a separate pay item.

3.03 Gravity Sewer and Force Main Backfill

- A. Initial Backfill:
 - 1. This backfill is defined as that material which is placed over the pipe from the spring line to a point 6 inches above the top of the pipe. For gravity sewer piping the material shall be Class I (No. 9 crushed stone aggregate) and may be machine placed without compaction. Uneven places in the backfill shall be leveled by hand. For force main piping in areas not subject to vehicular traffic, initial backfill material shall be earth material free of rocks, acceptable to the Engineer or with Class I material when a condition exists mentioned in Paragraph A, 3. below. For force main piping in paved areas, initial backfill shall be Class I material.
 - 2. Material used, whether earth or Class I, in the initial backfilling is **not** a separate pay item. Payment for the material is included in the unit price per linear foot of gravity sewer or force main.

Excavating, Backfilling and Compacting for Utilities

3. In areas where large quantities of rock are excavated and the available excavated earth in the immediate vicinity is insufficient for placing the required amount of backfill over the top of the pipe as set forth in Paragraph A.1, the Contractor shall either haul in earth or order Class I material for backfilling over the pipe. Neither the hauling and placement of earth nor the ordering and placement of Class I material to fulfill the backfill requirements set forth herein is considered a separate pay item.
- B. Final Backfill:
1. There are two cases where the method of final backfilling varies. The various cases and their trench situations are as follows:
 - a. Case I - Areas not subject to vehicular traffic.
 - b. Case II - Paved areas including streets, drives, parking areas, and walks.
 2. In all cases, walking or working on the completed pipelines, except as may be necessary in backfilling, will not be permitted until the trench has been backfilled to a point 6 inches above the top of the pipe. The method of final backfilling for each of the above cases is as follows:
 - a. Case I - The trench shall be backfilled from a point 6 inches above the top of the pipe to a point 8 inches below the surface of the ground with earth material free from large rock (greater than 6 inches in the longest dimension), acceptable to the Engineer. The remainder of the trench shall be backfilled with earth material reasonably free of any rocks.
 - b. Case II - The trench shall be backfilled from a point 6 inches above the top of the pipe to a point 12 inches below the existing pavement surface with Class I (No. 9 crushed stone aggregate) material. The backfill shall be mechanically tamped in approximately 6-inch layers to obtain maximum possible compaction. The remaining backfill shall be as follows:

For gravel surfaces - Class II (dense graded aggregate) material mechanically tamped to maximum possible compaction. The trench may be left with a slight mound if permitted by the Engineer.

For bituminous and concrete surfaces - Bituminous and concrete pavement sections as detailed on the Drawings and as specified for Bituminous Pavement Replacement and Concrete Pavement Replacement.
 3. Earth and Class I material used in final backfill is not a separate pay item. Payment shall be included in the price of gravity sewer and force main.
 4. Class II material used in final backfill shall be included in the unit price for gravity sewer and force main.
- C. A sufficient amount of Class II material shall be stockpiled to insure immediate replacement by the Contractor of any settled areas. No extra payment will be made for the filling in of settled or washed areas by the Contractor.

- D. Excavated materials from trenches, in excess of quantity required for trench backfill, shall be disposed of by the Contractor. It shall be the responsibility of the Contractor to obtain location or permits for its disposal, unless specific waste areas have been designated on the Drawings or noted in these Specifications. The cost of disposal of excess excavated materials, as set forth herein, no additional compensation being allowed for hauling or overhaul.

3.04 Placement of Identification Tape

- A. The placement of detectable underground marking tape shall be installed over all utility lines. Care shall be taken to insure that the buried marking tape is not broken when installed and shall be Lineguard brand encased aluminum foil, Type III. The identification tape is manufactured by Lineguard, Inc., P.O. Box 426, Wheaton, IL 60187.
- B. The identification tape shall bear the printed identification of the utility line below it, such as "Caution - Buried Below". Tape shall be reverse printed; surface printing will not be acceptable. The tape shall be visible in all types and colors of soil and provide maximum color contrast to the soil. The tape shall meet the APWA color code, and shall be 2 inches in width. Colors are: yellow - gas, green - sewer, red - electric, blue - water, orange - telephone, brown - force main.
- C. The tape shall be the last equipment installed in the trench so as to be first out. The tape shall be buried 4 to 6 inches below top of grade. After trench backfilling, the tape shall be placed in the backfill and allowed to settle into place with the backfill. The tape may be plowed in after final settlement, installed with a tool during the trench backfilling process, unrolled before final restoration or installed in any other way acceptable to the Owner or Engineer.

3.05 Placement of Location Wire

- A. The placement of detectable underground location wire shall be installed above all non-metallic water mains and force mains. Care shall be taken to insure that the buried wire is not broken.
- B. The location wire shall be no smaller than AWG No. 8, soft drawn, 98 percent conductivity copper and insulated with THW insulation.
- C. The location wire shall be continuous from valve box to valve box and shall be terminated (unconnected) with a wire nut and enough Aloose® wire to extend 24 inches outside the valve box.

END OF SECTION



Part 1 - General

1.01 Work Included

- A. The Contractor shall do all Work and take all measures necessary to control soil erosion resulting from construction operations, shall prevent the flow of sediment from the construction site, and shall contain construction materials (including excavation and backfill) within his protected working area so as to prevent damage to the adjacent wetlands or water courses.
- B. The Contractor shall not employ any construction method that violates a rule, regulation, guideline or procedure established by Federal, State or local agencies having jurisdiction over the environmental effects of construction.
- C. Pollutants such as chemicals, fuels, lubricants, bitumen, raw sewage and other harmful waste shall not be discharged into or alongside of any body of water or into natural or man-made channels leading thereto.

Part 2 - Products

2.01 Materials

Silt checks shall be constructed of No. 1 coarse aggregate as defined by the Kentucky Transportation Cabinet. Filter fabric for sediment traps shall be of suitable materials acceptable to the Engineer. Bales may be hay or straw, and shall be reasonably clean and free of noxious weeds and deleterious materials.

Part 3 - Execution

3.01 Methods of Construction

- A. The Contractor shall use any of the acceptable methods necessary to control soil erosion and prevent the flow of sediment to the maximum extent possible. These methods shall include, but not be limited to, the use of silt fences, hay bales, water diversion structures, temporary revegetation, diversion ditches and settling basins.
- B. Construction operations shall be restricted to the areas of work indicated on the Drawings and to the area which must be entered for the construction of temporary or permanent facilities. The Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and fill operations and to direct the Contractor to provide immediate permanent or temporary pollution control measures to prevent contamination of the wetlands and adjacent watercourses. Such work may involve the construction of temporary berms, dikes, dams, sediment basins, slope drains, and use of temporary mulches, mats, or other control devices or methods as necessary to control erosion.

Erosion and Sediment Control

- C. Excavated soil material shall not be placed adjacent to the wetlands or watercourses in a manner that will cause it to be washed away by high water or runoff. Earth berms or diversions shall be constructed to intercept and divert runoff water away from critical areas. Diversion outlets shall be stable or shall be stabilized by means acceptable to the Engineer. If for any reason construction materials are washed away during the course of construction, the Contractor shall remove those materials from the fouled areas as directed by the Engineer.
- D. For Work within easements or rights-of-way, all materials used in construction such as excavation, backfill, roadway, and pipe bedding and equipment shall be kept within the limits of these easements or rights-of-way.
- E. The Contractor shall not pump silt-laden water from trenches or other excavation into the wetlands, or adjacent watercourses. Instead, silt-laden water from his excavations shall be discharged within areas surrounded by baled hay or into sediment traps or ensure that only sediment-free water is returned to the watercourses. Damage to vegetation by excessive watering or silt accumulation in the discharge area shall be avoided.
- F. Prohibited construction procedures include, but are not limited to the following:
 - 1. Dumping of spoil material into any streams, wetlands, surface waters, or unspecified locations.
 - 2. Indiscriminate, arbitrary, or capricious operation of equipment in wetlands or surface waters.
 - 3. Pumping of silt-laden water from trenches or excavations into surface waters, or wetlands.
 - 4. Damaging vegetation adjacent to or outside of the construction area limits.
 - 5. Disposal of trees, brush, debris, paints, chemicals, asphalt products, concrete curing compounds, fuels, lubricants, insecticides, washwater from concrete trucks or hydroseeders, or any other pollutant in wetlands, surface waters, or unspecified locations.
 - 6. Permanent or unauthorized alteration of the flow line of any stream.
 - 7. Open burning of debris from the construction work.
- G. Any temporary working roadways required shall be clean fill approved by the Engineer. In the event fill is used, the Contractor shall take every precaution to prevent the fill from mixing with native materials of the site. All such foreign fill materials shall be removed from the site following construction.

3.02 Erosion Checks

- A. The Contractor shall furnish and install baled hay or straw erosion checks surrounding the base of all deposits of stored excavated material outside of the disturbed area, and

where indicated by the Engineer. Checks located surrounding stored material shall be located approximately 6 feet from that material. Bales shall be held in place with two 2 inch by 2 inch by 3 feet wooden stakes. Each bale shall be butted tightly against the adjoining bale to preclude short circuiting of the erosion check.

- B. The Contractor shall remove silt and sediment from the site as it accumulates at erosion checks and repair damaged checks during construction.

- 3.03 The Contractor shall remove all erosion control materials from the site as soon as potential for erosion has been eliminated and when approved by the Engineer. Reseed area where hay bales or silt has been removed.

END OF SECTION



Part 1 - General

1.01 Summary

- A. Provide bituminous pavement for following applications, with prepared subbase and compacted base.
 - 1. Roads.
 - 2. Parking areas.
 - 3. Driveways.
 - 4. Walkways.
 - 5. Curbs.
- B. Provide striping for parking, roadway, and handicapped markings.

1.02 Submittals

Submit for approval product data, test reports.

1.03 Quality Assurance

Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

Part 2 - Products

2.01 Materials

- A. Prime coat: Cut-back asphalt.
- B. Tack coat: Emulsified asphalt.
- C. Asphaltic cement: AASHTO M226 and as required by local authorities.
- D. Aggregate: Crushed stone or crushed gravel.
- E. Traffic paint: Quick-drying chlorinated-rubber alkyd type, color as approved.
- F. Wheel-stops: Precast concrete of uniform color and texture with steel stakes.

Part 3 - Execution

3.01 NEW PAVEMENT INSTALLATION

- A. Asphalt/aggregate Mixture: Comply with local KDOT Standard Specifications for Highways and Bridges. Class as required by loading and use.
- B. Remove loose material from compacted subbase. Proof roll and check for areas requiring additional compaction. Report unsatisfactory conditions in writing. Beginning of work means acceptance of compacted subbase.
- C. Apply prime coat to prepared surface. Apply tack coat to previous laid work and adjacent in-place concrete surfaces.
- D. Place bituminous concrete at minimum temperature of 225 degrees F in strips not less than 10' wide overlapping joints in previous courses. Complete entire base course thickness before beginning surface course.
- E. Construct curbs, where required, to dimensions indicated or if not indicated to standard shapes. Provide tack coat between curb and pavement.
- F. Begin rolling when pavement can withstand weight of roller. Roll while still hot to obtain maximum density and to eliminate roller marks.
- G. Provide 4" lane and striping paint in uniform, straight lines. Provide wheelstops where indicated and securely dowel into pavement. Protect work from traffic and damage.
- H. Test in-place asphalt work for thickness and smoothness. Remove and replace defective work and patch to eliminate evidence of patching. Provide the following minimum thickness and smoothness unless otherwise greater thickness is required on the Drawings:
 - 1. Subbase course: 9-inch DGA.
 - 2. Base course: 5-inch.
 - 3. Surface course: 1 1/2-inch plus or minus 1/4-inch at drives and parking; 1 1/2-inch plus or minus 1/4-inch at walks.
 - 4. Surface course smoothness: Plus or minus 1/8-inch in 10 feet. No ponding of water is acceptable.
- I. Thickness of bituminous surface and base shall be determined by coring of the newly constructed pavement in accordance with Kentucky Method 64-420-04, Paragraphs 1.2, 1.3, 2, and 3, with the following exceptions:
 - 1. Coring frequency shall be 500 feet.
 - 2. Exploratory cores for a deficiency shall be spaced at 100 foot intervals.

3. Excess thickness will be considered as included in the Contract price per unit.
4. Deficient thickness between 2-inch and $\frac{3}{4}$ -inch will require a deduction from the unit price in the proportion of the actual thickness to the design thickness for the area of the deficiency as determined in accordance with the stipulated method. Deficient thickness of greater than $\frac{3}{4}$ -inch will require an additional 1-inch layer of surface to be overlaid over the area of the deficiency.

END OF SECTION



Part 1 - General

1.01 Summary

- A. Provide Portland cement concrete paving at following locations, with prepared subbase and compacted base.
 - 1. Driveways and vehicular entrances.
 - 2. Walkways.
 - 3. Curbs.

1.02 Submittals

Submit for approval product data, mix design, mock-ups, test reports.

1.03 Quality Assurance

Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

Part 2 - Products

2.01 Materials

- A. Concrete mix design: Specific mixes as required for sidewalks, curbs, and vehicular ways. Submit mix proposed for use, for approval, as detailed in Division 3.
- B. Exposed aggregate paving:
 - 1. Aggregate to match approved sample.
 - 2. Retarder.
- C. Reinforcing: 6 x 6, 1.9 x 1.9 welded flat wire mesh and ASTM A36 deformed steel bars.
- D. Joints: Preformed joint fillers/sealers.
- E. Finish:
 - 1. Paving: Fine bristled stiff broom.
 - 2. Exposed aggregate finish: Match approved sample.
 - 3. Imprinting: Tools and hardeners by Bomanite Corp.

4. Curbs: Steel form finish.
- F. Thickness (Unless shown otherwise on the drawings):
1. Driveways and vehicular entrances - 6 inches.
 2. Walkways - 4 inches.
 3. Curbs - 6 inches.

Part 3 - Execution

3.01 Installation

- A. Proof roll subbase and check for unstable areas. Report unsatisfactory conditions in writing. Beginning paving work means acceptance of subbase.
- B. Comply with Division 3 for concrete mix, testing, placement, joints, tolerances, curing, repairs, and protection.

END OF SECTION

Part 1 General

1.01 Scope

- A. Provide all labor, materials, equipment, and incidentals necessary to construct and disinfect (if required) all piping and appurtenances located outside the buildings and structures and test as shown on the Drawings and as specified herein.
- B. Site piping covered under this Section shall begin at the outside face of structures and buildings, except where there is no joint at the outside face, then site piping shall begin not more than two feet beyond the face of the structure or building.
- C. Site piping shall include all aerial piping.

1.02 Submittals

- A. Complete shop drawings and product data on all piping and accessories shall be submitted to the Engineer in accordance with the requirements of Section 01340 of these Specifications.
- B. Shop drawings shall indicate piping layout in plan and/or elevations and shall include a complete schedule of all pipe, fittings, specials, hangers], and supports. Special castings shall be clearly detailed showing all pertinent dimensions. Special coatings shall be clearly identified.
- C. The Contractor shall furnish the Inspector with lists of all pieces of pipe and fittings in each shipment received. These lists shall give the serial or mark number, weight, class, size and description of each item received.
- D. The Contractor shall submit written evidence to the Engineer that the products furnished under this Section will conform with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the pipe supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on samples of pipe materials.

1.03 Quality Assurance

If ordered by the Engineer, each pipe manufacturer shall furnish the services of a competent factory representative to supervise and/or inspect the installation of pipe. This service will be furnished for a minimum of five days during initial pipe installation.

Part 2 Products

2.01 Ductile Iron Pipe (DIP)

Ductile iron pipe, fittings, and accessories shall be as specified in Part 2 of Section 15062 of these Specifications.

2.02 Reinforced Concrete Pipe (RCP)

A. Reinforced Concrete Pipe (Storm Drains)

1. Pipe: Pipe shall be bell and spigot reinforced concrete conforming to ASTM C 76 for Class III pipe. Wall thickness design shall correspond to Wall B. Reinforced concrete pipe shall be supplied in lengths of at least six feet.
2. Joints: Pipe shall have rubber gasket type joints conforming to ASTM C 443 or ASTM C 361. A rectangular groove shall be supplied in the spigot end to receive the rubber gasket, and it shall be so formed that when the joint is complete the gasket will be deformed to a rectangular shape and confined on all four sides. Bell and spigot surfaces shall be accurately formed and smooth to provide a close sliding fit with a nominal clearance of 1/16-inch.
3. Acceptance
 - a. Acceptance for pipe shall be on the basis of plant load-bearing tests, material tests, and inspection of manufactured pipe for visual defects and imperfections as described in Paragraph 5.1.1 of ASTM C 76.
 - b. Provide results of tests on pipe and joint material performed by an independent testing laboratory approved by the Engineer. Include materials and crushing loads for pipe of each size in accordance with applicable specifications.
 - c. Each length of pipe shall be stamped by a regular employee of the approved testing laboratory.
 - d. Inspect pipe after delivery for laboratory stamp, shape, cracks, uniformity, blisters and imperfect surfaces, hammer test, damaged ends, and gasket grooves.

2.03 Polyvinyl Chloride (PVC) Gravity Sewer or Drain Pipe

- A. Polyvinyl chloride gravity sewer or drain pipe shall be as specified in Part 2 of Section 15069 of these Specifications.

B. Manhole Connections

1. Solid Wall and Closed Profile Wall Pipe: The sewer shall be connected to manholes utilizing a standard pipe section.
2. Open Profile Wall Pipe: The sewer shall be connected to manholes with an adapter piece. The adapter piece shall have an open profile pipe bell and a solid wall pipe spigot for penetrating the manhole wall.

- C. Acceptance: Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that the pipe and fittings were manufactured and tested in accordance with the applicable standards.

2.04 Cast Iron Soil Pipe (CISP)

A. Underground Sanitary Drainage Pipe and Fittings

1. Provide cast iron pipe, ASTM A 74, Class SV, coated with coal-tar pitch enamel conforming to AWWA C203.
2. Joints shall be bell-and-spigot type, ASTM A 74, with rubber gaskets conforming to ASTM C564.

2.05 Copper Tubing

- A. Exposed copper tubing for water or air shall be seamless harddrawn copper tube conforming to the requirements of ASTM B 88, Type L. Buried copper tubing shall be seamless, annealed copper tube conforming to the requirements of ASTM B 88, Type K. Annealed copper tube may be furnished in straight lengths or coils.
- B. Fittings for copper tube shall be wrought copper conforming to ASTM B 75 and ANSI B 16.22 for silver brazed joints.
- C. Copper tubing for instrument air service in sizes 5/8-inch outside diameter and smaller shall be coated, seamless, bright annealed copper tube conforming to ASTM B 68, Type DHP. Wall thickness of copper tube shall be as follows:

Tube Outside Diameter, Inches	Wall Thickness, Inches
1/4	0.030
3/8	0.032
1/2	0.035
5/8	0.040

- D. Fittings for annealed copper tube in instrument air service shall be of the flareless, compression type, Hoke "Gyrolok", Crawford "Swagelok", or Parker "Tribble-Lok", conforming to ASTM B 16 or B 124.
- E. Instrument air tubing shall be factory coated with a layer of black PVC meeting the requirements of ASTM D 1047, IPCEA S-61-402, and applicable UL standards. Minimum coating thickness shall be 0.032-inch. Unless otherwise shown, minimum size of instrument air tubing shall be 3/8-inch outside diameter.

2.06 Polyethylene Pipe for Gas Service

A. Pipe and Fittings

- 1. Pipe and fittings shall be high molecular weight polyethylene conforming to ASTM D 1248, Grade P34. The pipe shall have a material designation code of PE 3408 in accordance with ASTM D 3350. All pipe shall conform to the requirements of ASTM 2513 and shall be Class B with antioxidant and UV stabilizer.
- 2. Pipe and fittings shall be SDR 11.
- 3. Pipe fittings shall meet the requirements of ASTM D 2683 for socket type fittings or ASTM D 3261 for butt type fittings.

2.07 Miscellaneous Accessories

A. Flexible Adapter Couplings

- 1. Couplings for pipe sizes 15-inches in diameter and less shall be elastomeric plastic sleeves designed to connect pipes of dissimilar materials. Adapters shall provide a positive seal against infiltration and exfiltration and remain leakproof and rootproof up to 4.3 psi. The adapter manufacturer shall provide all stainless steel clamps and required accessories.
- 2. Couplings shall be products of Fernco and shall be installed in accordance with the manufacturer's recommendations.

B. Flexible Adapter Donuts

- 1. Adapter donuts shall be elastomeric PVC, compressible seals designed for sealing joints between sewer pipes of different sizes and/or dissimilar materials. Adapters shall provide a positive seal against infiltration and exfiltration and remain leakproof and rootproof up to 4.3 psi.
- 2. Donuts shall be products of Fernco and shall be installed in accordance with the manufacturer's recommendations.

- C. **Detection Tape:** Detection tape shall be composed of a solid aluminum foil encased in a protective plastic jacket. Tapes shall be color coded in accordance with APWA color codes with the text describing pipe and material. Tape lettering shall be permanently printed with no surface printing allowed. Tape width shall be minimum 2-inches when buried less than 10-inches below the surface. Tape width shall be minimum 3-inches when buried greater than 10-inches and less than 20-inches. Detection tape shall be equal to Lineguard Type III Detectable or Allen Systems Detectatape.
- D. **Retainer Glands:** Retainer glands shall be Megalug, Series 1100, as manufactured by EBAA Iron.
- E. **Retainer Glands:** Retainer glands shall be ductile iron and shall be equal to ACIPCO A-90857.
- F. **Harness Rods**
 - 1. Harness rods shall be manufactured in accordance with ASTM A 36. Harness rods shall be hot dip galvanized before backfilling.
 - 2. Eye bolts shall be of the same diameter as specified in AWWA C111 for that pipe size. The eye shall be welded closed. Where eye bolts are used in conjunction with harness rods, an appropriate size washer shall be utilized with a nut on each end of the harness rod. Eye bolts shall be of the same material and coating as the harness rods.
- G. **Service Clamps:** Service clamps shall be ductile iron, double strap clamps equal to Mueller.

Part 3 Execution

3.01 Existing Underground Utilities and Obstructions

- A. The Drawings indicate utilities or obstructions that are known to exist according to the best information available to the Owner. The Contractor shall call the Utilities Protection Center (UPC) (325-5000 or 1-800-282-7411) as required by Kentucky law (Code Section 25-9-1 through 25-9-13) and all utilities, agencies or departments that own and/or operate utilities in the vicinity of the construction work site at least 72 hours (three business days) prior to construction to verify the location of the existing utilities.
- B. **Existing Utility Location:** The following steps shall be exercised to avoid interruption of existing utility service.
 - 1. Provide the required notice to the utility owners and allow them to locate their facilities according to Kentucky law. Field utility locations are valid for only 10 days after original notice. The Contractor shall ensure at the time of any excavation that a valid utility location exists at the point of excavation.

2. Expose the facility, for a distance of at least 200 feet in advance of pipeline construction, to verify its true location and grade. Repair, or have repaired, any damage to utilities resulting from locating or exposing their true location.
3. Avoid utility damage and interruption by protection with means or methods recommended by the utility owner.
4. Maintain a log identifying when phone calls were made, who was called, area for which utility relocation was requested and work order number issued, if any. The Contractor shall provide the Engineer an updated copy of the log bi-weekly, or more frequently if required.

C. Conflict with Existing Utilities

1. Horizontal Conflict: Horizontal conflict shall be defined as when the actual horizontal separation between a utility, main, or service and the proposed piping does not permit safe installation of the piping by the use of sheeting, shoring, tying-back, supporting, or temporarily suspending service of the parallel or crossing facility. The Contractor may change the proposed alignment of the piping to avoid horizontal conflicts if the new alignment remains within the available right-of-way or easement, complies with regulatory agency requirements and after a written request to and subsequent approval by the Engineer. Where such relocation of the piping is denied by the Engineer, the Contractor shall arrange to have the utility, main, or service relocated.
2. Vertical Conflict: Vertical conflict shall be defined as when the actual vertical separation between a utility, main, or service and the proposed piping does not permit the crossing without immediate or potential future damage to the utility, main, service, or the piping. The Contractor may change the proposed grade of the piping to avoid vertical conflicts if the changed grade maintains adequate cover and complies with regulatory agencies requirements after written request to and subsequent approval by the Engineer. Where such relocation of the piping is denied by the Engineer, the Contractor shall arrange to have the utility, main, or service relocated.

D. Electronic Locator: Have available at all times an electronic pipe locator and a magnetic locator, in good working order, to aid in locating existing pipe lines or other obstructions.

E. Water and Sewer Separation

1. Potable water mains should maintain a minimum 10 foot edge-to-edge separation from sewer lines, whether gravity or pressure. If the main cannot be installed providing the 10 foot separation, the separation may be reduced, provided the bottom of the water main is a minimum of 18-inches above the top of the sewer. Should neither of these two separation criteria be possible, the potable water main shall be installed below the sewer with a minimum vertical separation of 18-inches and the water main shall be encased in concrete with a minimum depth of 6-inches.

2. Where water mains cross the sewer, the pipe joint adjacent to the pipe crossing the sewer shall be cut to provide maximum separation of the pipe joints from the sewer.
3. No water main shall pass through, or come in contact with, any part of a sanitary sewer manhole.

3.02 Location and Grade

- A. The Drawings show the alignment and grade of the piping and the location of other appurtenances.
- B. Prior to clearing and grubbing, construction staking shall conform to the requirements of Section 01055 of these Specifications.

3.03 Laying and Pipe Assembly

A. Installation

1. Proper implements, tools and facilities shall be provided for the safe performance of the work. All pipe, fittings, valves and hydrants shall be lowered carefully into the trench by means of slings, ropes or other suitable tools or equipment in such a manner as to prevent damage to piping materials and protective coatings and linings. Under no circumstances shall piping materials be dropped or dumped into the trench.
2. All pipe, fittings, valves, hydrants, and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Engineer, who may prescribe corrective repairs or reject the materials.
3. All lumps, blisters and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and free from dirt, sand, grit or any foreign materials before the pipe is laid. No pipe containing dirt shall be laid.
4. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing or other materials shall be placed in the pipe at any time.
5. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.
6. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade, shall not be permitted.

7. Provide detection tape for all non-metallic pipe. Detection tape shall be buried 4 to 10-inches deep. Should detection tape need to be installed deeper, the Contractor shall provide 3-inch wide tape. In no case shall detection tape be buried greater than 20-inches from the finish grade surface.

B. Alignment and Gradient

1. Lay pipe straight in alignment and gradient or follow true curves as nearly as practicable. Do not deflect any joint more than the maximum deflection recommended by the manufacturer.
2. Maintain a transit, level and accessories on the job to lay out angles and ensure that deflection allowances are not exceeded.
3. The Contractor shall check the invert elevation for gravity sewer or drain pipe and storm drains at each manhole at least three times daily, start, mid-day and end of day. Elevations shall be checked more frequently if more than 100 feet of pipe is installed in a day or if the pipe is being constructed at minimum slope.
4. The Contractor shall check the horizontal alignment of the pipeline at the same schedule as for invert elevations.

- C. Expediting of Work: Excavate, lay the pipe, and backfill as closely together as possible. Do not leave unjointed pipe in the trench overnight. Backfill and compact the trench as soon as possible after laying and jointing is completed. Cover the exposed end of the installed pipe each day at the close of work and at all other times when work is not in progress. If necessary to backfill over the end of an uncompleted pipe or accessory, close the end with a suitable plug, either push-on, mechanical joint, restrained joint or as approved by the Engineer.

D. Joint Assembly

1. Push-on, mechanical, flange and restrained type joints shall be assembled in accordance with the manufacturer's recommendations.
2. Each restrained joint shall be inspected by the Contractor to ensure that it has been "homed" 100 percent.
3. The Contractor shall internally inspect each pipe joint to insure proper assembly for pipe 24-inches in diameter and larger after the pipe has been brought to final alignment.
4. Field welding of steel pipe joints shall conform to the requirements of AWWA C206. All welding shall be performed by persons meeting the qualification requirements of ANSI/AWS D1.1.

- E. Cutting Pipe: Cut ductile iron pipe using an abrasive wheel saw. Cut PVC pipe using a suitable saw; remove all burrs and smooth the end before jointing. The Contractor shall cut the pipe and bevel the end, as necessary, to provide the correct length of

pipe necessary for installing the fittings, valves, accessories and closure pieces in the correct location. Only push-on or mechanical joint pipe shall be cut.

- F. Lining Repair: Repair polyethylene or polyurethane linings and recoat spigot ends of cut pipe with a product equal to Protecto 101 or Madewell 1104 coal tar epoxy in accordance with the manufacturer's recommendations and as specified below:
1. Remove all burrs and areas of loose lining materials by sanding or scraping to bare metal.
 2. Remove oil and lubricants used during field cutting.
 3. Lining shall be stripped back a minimum of 1-inch from the spigot end into well adhered lined areas.
 4. Roughen 1 to 2-inches of good lining with a rough grade (40 grit) emery paper, rasp or small chisel, to allow an overlap between new and existing lining.
 5. Apply lining repair material in the number of coats required to match the thickness requirements as specified in Part 2 of this Section and in accordance with the manufacturer's recommendations.
- G. Polyethylene Encasement: Installation shall be in accordance with AWWA C105 and the manufacturer's instructions. All ends shall be securely closed with tape and all damaged areas shall be completely repaired to the satisfaction of the Engineer.

3.04 Connections to Existing Piping

- A. Make connections to existing pipe lines as shown on the Drawings.
- B. Location: Before laying pipe, locate the points of connection to existing piping and uncover as necessary for the Engineer to confirm the nature of the connection to be made.
- C. Interruption of Services: Make connections to existing piping only when system operations permit. Operate existing valves only with the specific authorization and direct supervision of the Owner.
- D. Tapping Saddles and Tapping Sleeves
1. Holes in the new pipe shall be machine cut, either in the field or at the factory. No torch cutting of holes shall be permitted.
 2. Prior to attaching the saddle or sleeve, the pipe shall be thoroughly cleaned, utilizing a brush and rag, as required.
 3. Before performing field machine cut, the watertightness of the saddle or sleeve assembly shall be pressure tested. The interior of the assembly shall be filled with water. An air compressor shall be attached, which will induce a test

pressure as specified in this Section. No leakage shall be permitted for a period of five minutes.

4. After attaching the saddle or sleeve to existing piping, but prior to making the tap, the interior of the assembly shall be disinfected. All surfaces to be exposed to potable water shall be swabbed or sprayed with a one percent hypochlorite solution.
- E. Connections Using Solid Sleeves: Where solid sleeves are shown on the Drawings, the Contractor shall furnish materials and labor necessary to make the connection using a solid sleeve to the existing pipe line.
- F. Connections Using Flange Filler: Flange filler shall be used only where shown on the Drawings or approved by the Engineer to make up minor differences in pipe length less than 3-inches. Joint bolt length shall be increased by the thickness of the flange filler.
- G. Connections Using Mechanical Pipe Couplings: Where pipe couplings are shown on the Drawings, the Contractor shall furnish materials and labor necessary to make the connection using a pipe coupling to the existing pipe line, including all necessary cutting, plugging and backfill.
- H. Connections to Pressure Mains
1. Connections to ductile iron pipe pressure mains shall be by the direct tap method or service clamp, as detailed on the Drawings in full accordance with AWWA requirements.
 2. Connections to polyvinyl chloride pipe shall be made using a full body service clamp.
 3. Pressure ratings for connections shall be the same as the pressure rating for the pipe.
- I. Hydrants: Hydrants shall be attached to the water main by the following method:
1. For mains 12-inches and smaller, the isolation valve shall be attached to the main by connecting the valve to the hydrant tee.
 2. For mains larger than 12-inches, the isolation valve shall be attached to the main by providing an anchor coupling between the valve and tapping saddle.
 3. The isolation valve shall be attached to the hydrant by providing an anchor coupling between the valve and hydrant.

3.05 Thrust Restraint

- A. Provide restraint at all points where hydraulic thrust may develop.

- B. Retainer Glands: Provide retainer glands where shown on the Drawings and on fire hydrants and all associated fittings, valves and related piping. Retainer glands shall be installed in accordance with the manufacturer's recommendations, particularly, the required torque of the set screws. The Contractor shall furnish a torque wrench to verify the torque on all set screws which do not have inherent torque indicators.
- C. Harnessing
1. Provide harness rods only where specifically shown on the Drawings or directed by the Engineer.
 2. Where possible, harness rods shall be installed through the mechanical joint bolt holes. Where it is not possible, provide 90 degree bend eye bolts.
- D. Concrete Thrust Collars: Collars shall be constructed as shown on the Drawings. Concrete shall be 3,500 psi as shown on the Drawings as specified in Section 03010 of these Specifications. Reinforcing steel shall be as shown on the Drawings and as specified in Section 03010 of these Specifications. The thrust collar shall be a weld on collar as specified in this Section. Weld-on collar shall be continuously welded to the pipe by the pipe manufacturer.
- E. Concrete Blocking
1. Where shown on the Drawings, provide concrete blocking for all bends, tees, valves, and other points where thrust may develop, except where other exclusive means of thrust restraint are specifically shown on the Drawings.
 2. Concrete shall be 3,500 psi as specified in Section 03010 of these Specifications.
 3. Form and pour concrete blocking at fittings as shown on the Drawings and as directed by the Engineer. Pour blocking against undisturbed earth. Increase dimensions when required by over excavation.

3.06 Installation of Polyethylene Pipe for Gas Service

- A. Pipe shall be installed in accordance with the requirements of 49 CFR 192 and ASTM D 2774.
- B. Workmanship: Pipe shall be cut accurately to measurements established at the job site and worked into place without springing or forcing. Pipes shall be installed to permit free expansion and contraction without damage to joints, hangers, or the building.
- C. Changes in direction shall be made with fittings.
- D. Pitch/Grade: All piping shall be installed with sufficient pitch to ensure drainage and venting.

- E. Joints: All joints shall be made by persons qualified in accordance with the requirements of 49 CFR 192.
- F. Welded Connections
 - 1. Welded connections shall be made in accordance with ASTM D 2567 and the manufacturer's recommendations.
 - 2. Mitering or notching pipe to form elbows and tees will not be permitted. Field and shop bevels shall be in accordance with the recognized standards and shall be performed by mechanical means. Flanges and branches shall be set true. This alignment shall be preserved during the welding operations.
 - 3. Defective welds shall be removed and replaced at no additional cost to the owner. Repairing of defective welds by adding new material over the defects or by peening will not be permitted.
- G. Install detection tape in the same trench as the polyethylene gas pipe with one foot of cover between the pipe and tape. Tape shall be positioned directly over the pipe to be located.
- H. All pipe shall be tested in accordance with the requirements of Section 02666 of these Specifications. If inspection or test shows defects, such defective work or material shall be replaced. All repairs to piping systems shall be made with new material. No caulking on screwed joints, cracks or holes will be acceptable. Failed welds must be cut out and replaced. Where it becomes necessary to replace pieces of pipe, such replacements shall be in the same length as the defective piece. Tests shall be repeated after all defects have been corrected.

3.07 Inspection and Testing

All pressure and leakage testing shall be performed in accordance with the requirements of Section 02666 of these Specifications.

3.08 Insulation and Heat Tracing

Provide insulation and heat tracing in accordance with Section 15250 of these Specifications.

3.09 Disinfection

All potable water lines shall be disinfected in accordance with Section 02675 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope

The work covered by this Section includes furnishing all labor, equipment and materials required to install brick and precast concrete manholes; storm drain inlets; and piping appurtenances as described herein and/or shown on the Drawings.

1.02 Design Requirements

- A. Manholes shall be constructed of specified materials to the sizes, shapes and dimensions and at the locations shown on the Drawings or as otherwise directed by the Engineer. The height or depth of the manhole will vary with the location. Unless shown otherwise on the Drawings, the top of the manhole frame will be at the finished grade of the pavement or 18-inches above the finished ground surface and inverts will be at the elevations shown on the Drawings.
- B. Where the difference in the invert elevation of a sewer 18-inches in diameter or smaller and any other sewer intersecting in one manhole is two feet or more, a drop manhole shall be constructed as shown on the Drawings. They shall be similar in construction to the standard manhole except that a drop connection of pipe and fittings of the proper size and material shall be constructed outside the manhole and supported by 4,500 psi concrete.

1.03 Submittals

- A. Complete product data on frames, covers and steps shall be submitted to the Engineer in accordance with the requirements of Section 01340 of these Specifications.
- B. Complete product data on all piping appurtenances shall be submitted in accordance with the requirements of Section 01340 of these Specifications.

1.04 Quality Assurance

- A. Prior to delivery, all basic materials specified herein shall be tested and inspected by an approved independent commercial testing laboratory or, if approved by the Engineer, certified copies of test reports prepared by the manufacturer's testing laboratory will be acceptable. All materials which fail to conform to these Specifications shall be rejected.
- B. After delivery to the site, any materials which have been damaged in transit or are otherwise unsuitable for use in the Work shall be rejected and removed from the site.

Part 2 Products

2.01 Manholes

- A. Concrete and Reinforcement
 - 1. Concrete used in construction shall be 4,500 psi concrete conforming to the requirements of Section 03010 of these Specifications.
 - 2. Steel reinforcement shall conform to the requirements of Section 03010 of these Specifications.
- B. Brick: Brick used in manhole construction shall be either solid or cored, medium hard or better, Grade MS brick conforming to requirements of ASTM C 32 for sewer and manhole brick.
- C. Mortar: Mortar shall be made of one part Portland cement and two parts clean sharp sand. Cement shall be Type 1 and shall conform to ASTM C 150. Sand shall meet the requirements of ASTM C 144.
- D. Round Precast Concrete Manholes: Provide manholes and other precast concrete products in accordance with the following:
 - 1. Precast concrete sections shall meet the requirements of ASTM C 478. The minimum compressive strength of the concrete in precast sections shall be 4,000 psi.
 - 2. The minimum wall thickness shall be one-twelfth of the inside diameter of the base, riser or the largest cone diameter. Additionally, the wall thickness shall be sufficient for the proper installation of the rubber boots.
 - 3. Transition slabs which convert bases larger than four feet in diameter to four foot diameter risers shall be designed by the manhole manufacturer to carry the live and dead loads exerted on the slab.
 - 4. Seal joints between precast sections by means of rubber O-ring gaskets or flexible butyl rubber sealant.
- E. Square and Rectangular Precast Manholes and Vaults
 - 1. Precast concrete sections shall meet the requirements of ASTM C 913. The minimum 28 day compressive strength of the concrete in precast sections shall be 4,000 psi.
 - 2. The design of each structure shall be the responsibility of the manufacturer and shall conform to ACI-318 and the minimum structural design loading

requirements as defined in ASTM C 890. The minimum design dead load shall be based on the depth shown on the Drawings. The minimum design live load shall be A-16.

3. Transition slabs which connect rectangular or square sections to round riser sections shall be designed by the manufacturer to support the live and dead loads on the slab.
4. Precast sections shall be manufactured such that the spigot end is at the top of each section.
5. Dimensions for square and rectangular manholes are shown on the Drawings.

F. Manhole Frames and Covers

1. Cast iron frames and covers shall meet the requirements of ASTM A 48 for Class 30 gray iron and all applicable local standards. All castings shall be tough, close grained, smooth and free from blow holes, blisters, shrinkage, strains, cracks, cold shots and other imperfections. No casting will be accepted which weighs less than 95 percent of the design weight. Shop drawings must indicate the design weight and provide sufficient dimensions to permit checking. All castings shall be thoroughly cleaned in the shop and given two coats of approved bituminous paint before rusting begins.
2. Manhole frames and covers shall be equal to the following:

Type	Design Weight	Manufacturer's Reference	
Standard	270#	Neenah R-1695	Vulcan V-1349
Traffic	400#	Neenah R-1643	Vulcan V-1349
Watertight	400#	Neenah R-1916-F1	Vulcan V-2358

3. All frames and covers shall have machined horizontal bearing surfaces.
4. All manholes shall have standard frames and covers except where specifically shown otherwise on the Drawings.

G. Storm Drain Inlets

1. Frames and gratings shall be of the type shown on the Drawings. Iron castings shall conform to ASTM A 48, Class 30. All castings shall be true to pattern in form and dimensions, free from faults, sponginess, cracks, blowholes and other defects affecting their strength. Bearing surfaces between cast frames and gratings shall be machined, fitted together and match marked to prevent rocking.
2. Inlets, grates and frames in paved and roadway areas shall be rated for a HS-20 loading.

Site Piping Manholes and Appurtenances

3. Inlets, grates and frames in non-paved and non-roadway areas shall be rated for a minimum 2,000 pound wheel load unless shown otherwise on the Drawings.
 4. Minimum clear opening areas shall be as shown on the Drawings.
- H. **Joint Sealants:** Seal joints between precast sections by means of rubber O-ring gaskets or flexible butyl rubber sealant. Butyl rubber sealants shall meet the requirements of AASHTO M-198. Sealant shall be pre-formed type with a minimum nominal diameter of 1-inch. Butyl rubber sealant shall be equal to Kent Seal No. 2 or Concrete Sealants CS202.
- I. **Plastic Steps:** Manhole steps of polypropylene molded around a steel rod equal to products of M.A. Industries may be used.
- J. **Rubber Boots:** Provide preformed rubber boots and fasteners equal to those manufactured by Kor-N-Seal or Press Seal Gasket Corporation.

2.02 Miscellaneous Appurtenances

A. FRP Meter Boxes

1. Meter boxes shall be plastic. Material shall meet or exceed the following:
 - a. Tensile Strength: 3,400 psi (ASTM D 638).
 - b. Flexural Modulus: 191,000 psi (ASTM D 790).
 - c. Impact Strength, Izod: 0.6 feet 16-inch (ASTM D 256).
 - d. Deflection Temperatures: 200 degrees F (ASTM D 648).
2. Meter box shall be fitted with cast iron cover.
3. Minimum dimensions shall be 10-3/4 x 16-inches top and 18-1/2 x 13-1/4-inches at bottom and 12-inches deep.
4. Plastic meter boxes shall be equal to Ametek, Plymouth Products Division or Brooks Products, Inc.

B. Corporation Cocks and Curb Stops

1. Corporation cocks and curb stops shall be ground key type, shall be made of bronze conforming to ASTM B61 or B62 and shall be suitable for the working pressure of the system. Ends shall be suitable for compression type joint. Threaded ends for inlet and outlet of corporation cocks shall conform to AWWA C800; coupling nut for connection to flared copper tubing shall conform to ANSI B16.26.

2. Corporation cocks and curb stops shall be equal to Mueller.
- C. Service Clamps
1. Service clamps shall be ductile iron, double strap clamps.
 2. Service clamps shall be equal to Mueller.

Part 3 Execution

3.01 General

- A. Excavation for backfilling for all manholes covered under this Section shall conform to the requirements of Section 02200 of these Specifications.
- B. Top Elevations: Build manholes outside of paved areas to 18-inches above finished grade unless otherwise shown on the Drawings or directed by the Engineer. Build manholes in paved areas to existing grades.
- C. Drop Connections: Manholes requiring drop connections are shown on the Drawings. Construct drop connections of the same materials as the upstream sewer and in accordance with the details shown on the Drawings.
- D. Inlet and Outlet Pipe
1. Inlet and outlet pipes shall be supported outside the manhole in accordance with the requirements of Section 02200 of these Specifications.
 2. Where required, inlet and outlet pipes shall be cut-off flush with the interior surface of the manhole or utility vault walls.
- E. Inverts: All inverts shall be of 3,500 psi concrete meeting the requirements of Section 03010 of these Specifications, and shall conform to the shape indicated on the Drawings or as directed by the Engineer. The invert shall be carefully formed to the required size and grade by gradual and even changes in sections. Changes in directions of flow through the inlet shall be made to a true curve with as large a radius as the size of the inlet will permit.
- F. Invert Elevations: The invert elevations shown on the Drawings shall be for the invert at the centerline of the manhole. Prior to setting the laser or other vertical alignment control system for the sewer upstream of the manhole, the Contractor shall verify the elevation of the sewer installed at the manhole. Should the elevation differ from that shown on the Drawings, the Contractor shall take the following corrective action:
1. If the sewer is laid at negative grade, the Contractor shall remove and reinstall the sewer at the correct grade at no additional cost to the Owner.

Site Piping Manholes and Appurtenances

2. If the sewer is laid at a grade less than that shown on the Drawings, thus reducing the sewer's capacity, the Owner may require the sewer to be removed and relaid at the correct grade at no additional cost to the Owner. As a minimum, the grade to the next upstream manhole shall be adjusted such that the next upstream manhole shall be set at the correct elevation.
 3. If the sewer is laid at a grade greater than that shown on the Drawings, and if the Contractor can show that there are no conflicts with upstream existing utilities or obstructions, the Contractor shall adjust the grade of the next upstream manhole such that the next upstream manhole shall be set at the correct elevation. If such an adjustment, in the Engineer's opinion, is substantial, the grade adjustment shall be spread over multiple sections of the sewer. If such an adjustment, in the Owner's opinion, significantly reduces the sewer's capacity, the Owner may require the Contractor to remove and relay that portion of the sewer laid at the improper grade.
- G. Manholes shall be constructed such that their walls are plumb.
- H. The cast iron frame for the manhole cover shall be set at the required elevation and properly anchored to the masonry. Where manholes are constructed in paved areas, the top surface of the frame and cover shall be tilted to conform to the exact slope, crown and grade of the existing adjacent pavement.
- I. Masonry work shall be allowed to set for a period of not less than 24 hours. Outside forms, if any, then shall be removed and the manhole backfilled and compacted. All loose or waste material shall be removed from the interior of the manhole. The manhole cover then shall be placed and the surface in the vicinity of the work cleaned off and left in a neat and orderly condition.
- J. After backfilling has been completed, the excavated area, if located in a street, alley or sidewalk, shall be provided with a temporary surface.

3.02 Brick Construction

- A. All manhole bases, including curved manhole bases shall be constructed of concrete in accordance with details on the Drawings.
- B. After the foundation has been prepared and has been approved by the Engineer, the bottom shall be constructed to the required line and grade. After the bottom has been allowed to set for a period of not less than 24 hours, the manhole shall be constructed thereon, care being exercised to form the incoming and outgoing sewer pipes into the wall of the manhole at the required elevations.
- C. Brick shall be laid radially with mortar joints not more than 3/8-inch thick horizontally and not less than 3/8-inch wide vertically at the inside face of the manhole. Each sixth brick course shall be a "Stretcher" course. Inside joints shall be trowel struck flush joints to provide smooth, clean surfaces. Joints shall be broken in successive layers. Wall thickness for manholes 12 feet and less deep shall be 8-inches. Wall thickness for the portion of manholes over 12 feet deep shall be 12-inches.

- D. The manhole steps shall be inserted into the wall of the manhole at the proper locations and elevations as the work progresses and shall be securely embedded in the masonry.

3.03 Precast Manhole Construction

- A. Construct manholes as shown on the Drawings and in accordance with the requirements of ASTM C 891.
- B. Precast Concrete: Handle sections carefully to prevent cracking or chipping. Provide uniform bedding of the bottom section to prevent uneven loading. Install gaskets and joint sealants in accordance with manufacturer's recommendations to produce a watertight structure.
- C. Brick: Where bricks are used to adjust the frame and cover to grade, bed the bottom and sides of every brick in mortar. Apply a smooth coat of mortar, 3/4-inch thick, on the inside and outside.
- D. Pipe Connections for HDPE Pipe: Install the manhole entry pieces as follows:
 - 1. Do not cut the smoothwall manhole entry piece. Instead, cut the spigot end off of standard quarter, half or full length pipe so that the manhole entry piece is properly positioned in the manhole wall.
 - 2. Prepare the field cut end so that a standard sealing ring can be installed for a watertight joint in accordance with manufacturer's recommendations.
 - 3. Connect rubber boot to the manhole entry piece and to the manhole wall using fasteners recommended by the boot manufacturer.
- E. Pipe Connections: All pipes shall be connected to precast concrete manholes by a rubber boot provided in a cored or precast hole of the proper diameter.
- F. Frames and Covers: Unless frame and cover is at grade, the frame shall be cast into the cone section.
- G. Seal all manhole joints and lift holes, both inside and out, with grout. Between precast sections, this is in addition to joint sealant.

3.04 Surface Preparation and Shop Painting

Frames, covers and steps shall be cleaned, shop primed and shop painted with a bituminous paint in accordance with the requirements of Section 01640 of these Specifications.

3.05 Inspection and Testing

All manholes shall be tested in accordance with the requirements of Section 02666 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope

- A. Furnish all labor, materials, tools, equipment and related items required to perform tests of gravity pipelines and perform integrity and leakage tests of pressure and vacuum piping.
- B. The testing requirements covered under this Section shall apply to all piping systems covered under Sections 02610, 15060, 15062, and 15069 of these Specifications.

1.02 Submittals

Submittals shall conform to the requirements of Section 01340 of these Specifications and shall include a description of the testing procedures to be employed and the report form to be furnished.

Part 2 Products

2.01 Test Mediums

The Owner will provide the necessary water required for testing the Work. The Contractor shall furnish all other test mediums. The Contractor shall furnish all equipment, necessary piping and required labor to transport water from its source to the test location for use in testing.

2.02 Test Equipment

The Contractor shall furnish all labor and equipment, including required pumps with regulated bypass meters and gauges, for conducting of the piping tests.

Part 3 Execution

3.01 General

- A. The entire length of all pressurized piping and gravity lines shall be field tested for tightness by a test as described in this Section.
- B. The timing and sequence of testing shall be scheduled by the Contractor, subject to the approval of the Engineer. The Contractor shall provide the Engineer with a minimum of 24 hours notice prior to the start of any test. All tests must be observed by the Engineer.
- C. The Contractor shall repair any leaks discovered during the initial filling of the piping and during the testing sequence. All known and visible leaks shall be repaired, whether or not the leakage rate is within allowable limits.

3.02 Major Piping

- A. All piping not listed under Article 3.03 shall be tested in accordance with Article 3.04. This shall include gravity and pressure sewer and sludge lines; potable and non-potable water lines, whether cast iron, ductile iron, steel, copper or PVC. Storm drains shall be exempted from testing required by this Section.
- B. Clean and test lines before requesting final acceptance. Where any obstruction is met, clean the lines by means of rods, swabs, or other instruments. When requested by the Engineer, flush out lines and manholes before final inspection.
- C. Gravity Piping
 - 1. Pipe lines shall be straight and show a uniform grade between manholes. Correct any discrepancies discovered during inspection.
 - 2. Pipe joints for pipelines 30-inches in diameter and larger shall be air tested individually. The joint tester assembly shall be placed over the joint and shall pressurize the joint area to 4 psi. The pressure shall not drop more than 2 psi in 10 seconds. The joint tester assembly shall be equal to that as supplied by Cherne Industries, Inc.
 - 3. Infiltration Tests: Use only when groundwater is two feet above the top of the pipe.
 - a. Install suitable weirs in manholes selected by the Engineer to determine the leakage of ground water into the sewer. Measure leakage only when all visible leaks have been repaired and the ground water is two feet above the top of the pipe. If leakage in any section of the pipeline exceeds 100 gpd/inch/diameter/mile, locate and repair leaks. Repair methods must be approved by the Engineer. After repairs are completed, re-test for leakage.
 - b. Furnish, install and remove the necessary weirs, plugs and bulkheads required to perform the leakage tests. Where continuous monitoring of flow level is required, the Contractor shall provide and operate monitoring equipment.
 - 4. Exfiltration Tests: Choose one of the following when groundwater is not two feet above the top of the pipe.
 - a. Hydrostatic Test
 - i. Test pipe between manholes or structures with a minimum of 10 feet hydrostatic pressure, measured at the center of the pipe at the upstream manhole or structure.
 - ii. The ends of the pipe in the test section shall be closed with suitable watertight bulkheads. Inserted into the top of each bulkhead shall

be a 2-inch pipe nipple with an elbow. At the upper end of the test section, a 12-inch riser pipe shall be connected to the 2-inch nipple. The test section of pipe shall be filled through the pipe connection in the lower bulkhead which shall be fitted with a valve, until all air is exhausted and until water overflows the riser pipe at the upper end. Water may be introduced into the pipe 24 hours prior to the test period to allow complete saturation. House service lines, if installed, shall also be fitted with suitable bulkheads having provisions for the release of air while the test section is being filled with water.

- iii. During the test period, which shall extend over a period of 2 hours, water shall be introduced into the riser pipe from measured containers at such intervals as are necessary to maintain the water level at the top of the riser pipe. The total volume of water added during the test period shall not exceed that specified for infiltration.
5. PVC Deflection Test: Test PVC gravity sewer for excessive deflection by passing a "pig" through the line with a diameter equal to 95 percent of the nominal inside diameter of the pipe. Excavate and install properly any section of pipe not passing this test. Re-test until results are satisfactory. This test shall be performed within the first 30 days of installation and during final inspection, at the completion of this Contract.

D. Pressure Piping

1. All sections of pipeline subject to internal pressure shall be pressure tested in accordance with AWWA C600. A section of line will be considered ready for testing after completion of all thrust restraint and backfilling.
2. Each segment of pipeline between line valves shall be tested individually.
3. Test Preparation
 - a. For pipelines less than 24-inches in diameter, flush pipeline section thoroughly at flow velocities greater than 2.5 feet per second, adequate to remove debris from pipe and valve seats. For pipelines 24-inches in diameter and larger, the main shall be carefully swept clean and mopped, if directed by the Engineer. Partially operate valves and hydrants to clean out seats. Provide correctly sized temporary outlets in number adequate to achieve flushing velocities.
 - b. Provide temporary blocking, bulkheads, flanges and plugs as necessary, to assure all new pipe, valves, and appurtenances will be pressure tested.
 - c. Before applying test pressure, air shall be completely expelled from the pipeline and all appurtenances. Unless permanent air vents are in place, insert temporary corporation stops at highpoints to expel air as line is filled with water.

- d. Fill pipeline slowly with water. Provide a suitable pump with an accurate water meter to pump the line to the specified pressure. Differential pressure at valves and hydrants shall equal the maximum possible, but shall not exceed manufacturer's pressure rating. Where necessary, provide temporary back pressure to meet the differential pressure restrictions.
 - e. Valves and hydrants shall not be operated in either the opening or closing direction at differential pressures above their rated pressure.
4. The test pressure shall be measured at the lowest point in the test segment and shall be maintained for a minimum of two hours. Test piping in accordance with the minimum test pressures shown below:

Pipe Designation	Pipe Size, inches	Test Pressure, psi
Fire Service Connection	6"	150
Plant Water Service	2"	150

5. The test pressure shall not vary by more than 5 psi for the test duration. Should the pressure drop more than 5 psi at any time during the test period, the pressure shall be restored to the specified test pressure. Provide an accurate pressure gage with graduation not less than 5 psi.
6. Leakage: Leakage shall be defined as the quantity of water that must be pumped into the test section equal to the sum of the water, to maintain pressure within 5 psi of the specified test pressure for the test duration plus water required to return line to test pressure at the end of the test. Leakage shall be the total cumulative amount measured on a water meter.
7. Test Results: No test section shall be accepted if the leakage exceeds the limits determined under Section 4 of AWWA C600. The leakage test shall be repeated until the test section is accepted. All visible leaks shall be repaired regardless of leakage test results.
8. Completion: After a pipeline section has been accepted, relieve test pressure. Record type, size and location of all outlets on record drawings.

3.03 Miscellaneous Piping

- A. Upon completion of each piping system or sub-system, blow the lines free of dirt and debris and test in the presence of the Engineer. Wherever possible, test before the trench is backfilled. Drain piping shall be tested prior to encasement in concrete. The minimum test duration shall be one hour. The pipeline shall fail the test if a measurable pressure drop is observed. Unless specified otherwise in Divisions 2 through 17 of these Specifications, test in accordance with the following requirements:

Piping Testing and Acceptance

System	Test Medium	Test Pressure	Pipe Material
Low Pressure Air Lines (less than 4")	Air	150 psi	Stl
Chemical Feed Lines (Gases)	Nitrogen Gas	150 psi	BSP
Chemical Feed Lines (Liquids) Ferric Chloride Hypochlorite	Water Water	150 psi 150 psi	PVC PVC
Hydraulic Tubing	Service Fluid	150 psi above operating	All
Pneumatic Tubing Drain Piping (less than 6")	Air Water	150 psi 150 psi	All All

- B. Repair and retest any piping system found to be leaking until results are satisfactory to the Engineer.
- C. For chemical feed lines that will convey chemicals that react adversely with water, piping shall be purged with nitrogen gas to remove all water before piping is placed in service.

3.04 Major Air Piping

- A. All air piping, 4-inches and larger, subject to internal pressure not listed under Article 3.03 of this Section shall be tested in accordance with this Article.
- B. Each segment of pipeline between line valves shall be tested individually.
- C. Test Preparation
 1. For pipelines less than 24-inches, the pipeline shall be cleaned using a pig or swab to remove all dirt and debris. For pipelines 24-inches in diameter and larger, the pipeline shall be carefully swept. Partially operate valves to clean out seats.
 2. Provide temporary blocking, bulkheads, flanges, and plugs as necessary to assure all new pipe, valves, and appurtenances will be pressure tested. Provide an air tap as required for filling the pipeline.
 3. Test equipment to be provided by the Contractor shall include Air-Lock balls, braces, air hoses, air source, timer, cut-off valves, 30 psi pressure gauge with minimum graduations of 0.2 psi and an accuracy of ± 2 percent.
 4. Fill the pipeline slowly with air until the test pressure has been reached. Allow the pressure to stabilize for 15 minutes.

Piping Testing and Acceptance

- D. Test the pipeline at a test pressure of 25 psi for one hour. If a measurable pressure drop is observed by the end of the test period, the pipeline has failed the test. All leaks shall be located and repaired and the system retested until no measurable pressure drop is observed.
- E. Completion: After a pipeline has been accepted, relieve the test pressure. Submit a copy of the test results to the Engineer for review and approval.

3.05 Polyethylene Piping for Gas Service

- A. Upon completion of the gas piping system, blow lines free of dirt and debris and test in the presence of the Engineer.
- B. All tests shall be made before the piping is covered, concealed or backfilled.
- C. The testing requirements for the respective systems shall include all those of the applicable governing codes, such as state, local, and insurance, and those specified herein. The Contractor shall furnish all code-required inspection certificates to the Engineer.
- D. Systems receiving hydrostatic tests shall be filled, vented, and charged to test pressure. Exterior surfaces of the pipe shall show no cracks or leaks, and shall be completely drop dry.
- E. The minimum test pressure shall be 50 psi. The minimum test duration shall be one hour.
- F. The pipeline shall fail the test if a measurable pressure drop is observed or if any leakage is detected.

3.06 Manholes

- A. Prior to testing manholes for watertightness, all liftholes shall be plugged with a non-shrink grout, all joints between precast sections shall be properly sealed and all pipe openings shall be temporarily plugged and properly braced. Each manhole shall pass one of the following tests:
 - 1. Exfiltration Tests: The manhole, after proper preparation as noted above, shall be filled with water. The maximum allowable leakage shall be 0.1 gallon per hour per foot of diameter per foot of depth. Tests shall last a minimum of eight hours. The manholes may be backfilled prior to testing.
 - 2. Vacuum Tests: The manhole, after proper preparation as noted above, shall be vacuum tested prior to backfilling. The test head shall be placed at the inside of the top of the cone section and the compression head inflated to 40 psi to effect a seal between the vacuum base and the manhole structure. Connect the vacuum pump to the outlet port with the valve open. A vacuum of 10-inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed,

the time shall be measured for the vacuum to drop to 9-inches. The manhole shall pass if the time is greater than 60 seconds for 48-inch diameter manholes. If the manhole fails the initial test, necessary repairs shall be made with non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained. Vacuum testing equipment shall be equal to that as manufactured by P.A. Glazier, Inc.

3.07 Repairs

If the leakage exceeds the specified allowable limits, the point or points of leakage shall be sought out and remedied by the Contractor at no additional cost to the Owner. Repair methods must be approved by the Engineer.

3.08 Flushing and Cleaning

The systems shall not be used, except for chemical cleaning, until the Engineer has been assured that cleaning has been accomplished.

3.09 Final Acceptance

- A. No pipeline installation shall be accepted until all known and visible leaks have been repaired, whether or not the leakage is within the maximum allowable limits.
- B. The Contractor will certify that all required tests have been successfully completed before the Work is accepted.

END OF SECTION



Disinfection of Potable Water Facilities**Part 1 General****1.01 Scope**

- A. The work covered by this Section includes furnishing all labor, equipment, materials and chemicals required to disinfect all potable water facilities in accordance with the procedures specified herein.
- B. Upon completion of the construction and installation of equipment, the Contractor shall sterilize all plant units, piping, pumps, wells and connections thereto, all distribution system piping and storage tanks and any surfaces that shall be in contact with potable water.

1.02 Standards

Procedures for disinfecting water mains, water storage facilities, wells and water treatment plants, unless otherwise modified herein, shall conform to the requirements of AWWA Standards C651, C652, C653 and C654.

Part 2 Products**2.01 Disinfection Agent**

The disinfection agent shall be free chlorine or chlorine compound. The method of application and type of disinfecting agent shall both be acceptable to the Engineer.

Part 3 Execution**3.01 Disinfection Procedure**

- A. Prior to disinfection, all surfaces shall be thoroughly flushed with clear water after all debris and dirt has been removed.
- B. Disinfection shall be accomplished by the application of clear water containing a minimum of 50 parts per million (ppm) of available chlorine: in new lines at least 25 ppm free chlorine shall be applied. The chlorine bearing water shall remain in contact with the surfaces being sterilized for a period of not less than 24 hours. At the end of the contact period the chlorine residual in all units and at extremities of pipe lines and other representative points shall be at least 25 ppm.
- C. In the process of chlorinating newly constructed units and newly installed pipe, all valves or other appurtenances shall be operated at least five times while the units and pipelines are filled with the disinfection agent.
- D. Upon completion of the disinfection procedure, reduce the chlorine residual of disinfection water to levels required for discharge per requirements of federal, state and local regulatory agencies. Treat water with sulfur dioxide or other reducing

Disinfection of Potable Water Facilities

chemicals to neutralize chlorine residual. All units and piping shall be flushed with potable water until the chlorine residual remaining is one part per million or less and the replacement water throughout the units, upon suitable bacteriological tests, has proved to be of acceptable quality and in conformance with Standards for municipal water supplies. This satisfactory quality of water shall continue for two full days as demonstrated by laboratory examination of samples taken from a tap located and installed in such a way as to prevent outside contamination.

- E. No portion of new work shall be placed in service until disinfection has been completed and approved by the Engineer. Should the initial treatment fail to result in acceptable water, the chlorination procedure shall be repeated until satisfactory results are obtained.

END OF SECTION

Part 1 - General

1.01 Work Included

- A. This Section includes all labor, materials, equipment and related items required to complete the work of storm drainage shown on the Drawings and specified herein.
- B. This Section does not include the following related items:
 - 1. Clearing and grubbing.
 - 2. Earthwork.
 - 3. Pavements and curbs.
 - 4. Site Utilities.
 - 5. Electrical Work.

1.02 Permits and Codes

The intent of this Section of the Specifications is that the Contractor's bid on the Work covered herein shall be based upon the Drawings and Specifications, but that the Work shall comply with all applicable codes and regulations as amended by any waivers.

1.03 Local Standards

The term "local standards" as used herein means the standards of design and construction of the Kentucky Department of Highways.

Part 2 - Products

2.01 Circular Reinforced Concrete Pipe

- A. Pipe materials shall conform to the requirements of the Kentucky Department of Highways.
- B. Reinforced concrete pipe shall meet ASTM C76 AASHTO M170, and shall be in the diameter on the Drawings and Class III unless noted otherwise.
- C. Pipe joints shall be bell and spigot construction in accordance with ASTM C443.
- D. Rubber gaskets shall be Forsheda 138 gaskets in accordance with ASTM C 443 or approved equal.
- E. Pipe shall be as manufactured by Independent Concrete Pipe Co. or approve equal.

2.02 Precast Concrete Box Culverts

- A. Precast reinforced concrete box culverts shall meet ASTM C789 and/or ASTM C850 and shall be in the size shown on the Drawings and Class III unless noted otherwise
- B. Joints shall be tongue and groove construction and shall be filled with butyl mastic sealant during installation as recommended by culvert manufacturer.
- C. Precast reinforced concrete box culverts shall be as manufactured by Independent Concrete Pipe Co. or approved equal.

2.03 Precast Concrete Manholes

Manholes, frames, and covers shall be in accordance with Section 02735.

2.04 Precast Concrete Inlet/Outlet Treatments

- A. Precast concrete inlet/outlet treatments shall meet the requirements of the Kentucky Department of Highways and of the type and size shown on the Drawings.
- B. Castings shall be cast iron as manufactured by Neenah, Hoe, McKinley, Flockhart or approved equal.

Part 3 - Execution

3.01 Existing Improvements

Maintain in operating condition all active drains and other utilities encountered in the Project area. Repair to the satisfaction of the Engineer any surface or subsurface improvement damaged during the course of the Work (unless such improvement is shown to be abandoned or removed), whether or not such improvement is shown on the Drawings.

3.02 Protection of Piping Laid in Areas of Fill

Underground drains specified in this Section shall not be laid in areas of fill prior to the actual performance of the grading operation, unless the depth of the cover over such utilities below existing ground surface is at least 30 inches. Such depth of cover requirement may be reduced provided the pipe is protected by concrete cradling, encasement or other manner satisfactory to the Engineer.

3.03 Trenching and Backfilling

- A. General: Unless otherwise directed by the Engineer, trenches in which storm drainage lines are to be laid shall be excavated in open cut to the depths shown on the Drawings. In general, this shall be interpreted to mean that machine excavation in earth shall extend to an elevation permitting minimum depth of bedding material below.
- B. Width of Trench: Excavate trenches of sufficient width to provide free working space on each side of the pipe and to permit proper backfilling around the pipe.

1. Pipe trenches shall be made as narrow as practicable and shall not be widened by scraping or loosening material from the sides. Every effort shall be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed and consolidated.
 2. Trenches shall be excavated with approximately vertical sides between the elevation of the center of the pipe and an elevation 1 foot above the top of the pipe.
- C. **Sheeting and Bracing:** Sheet and brace trenches as necessary to protect workmen and adjacent structures. Comply with local regulations, or, in the absence thereof, with the "Manual of Accident Prevention in Construction", of the Associated General Contractors of America, Inc. Do not remove sheeting until trench is backfilled sufficiently to protect pipe and prevent injurious caving.
- D. **Water Removal:** Keep trenches free from water while construction therein is in progress. Under no circumstances lay pipe or appurtenances in water. Pump or bail water from bell hole to permit proper jointing of pipes. Conduct the discharge from trench dewatering to sediment controlled areas as specified in Section 02270.
- E. **Disposition of Existing Utilities:** Rules and regulations governing the respective utilities shall be observed in executing all work under this heading. Active utilities not shown on the Drawings shall be protected or relocated in accordance with written instructions of the Engineer and the Contract sum will be adjusted for such additional work. Inactive and abandoned utilities encountered in trenching operation shall be removed, plugged, or capped. In absence of specific requirements, plug or cap such utility lines at least 3 feet from new ditch line or as required by the local regulations.
- F. **Unclassified Excavation:** Materials to be excavated shall be unclassified, and shall include the removal of earth, rock, or other materials encountered in the excavating to the depth and extent shown or indicated on the Drawings. In the case of any change in the excavation, ordered in writing by the Engineer, the resulting changes in quantities shall be accurately computed, its value shall be determined in accordance with applicable Unit Prices agreed upon between the Owner and Contractor or subcontractors, and the Contract sum shall be adjusted accordingly.
1. **Blasting:** Obtain written approval of method from the Engineer before proceeding with rock excavation. Cover blasts with heavy timbers or mats. Set off no blasts within 25 feet of pipe already laid in trench. Protect earth backfill pipe already laid. Explosives shall be stored, handled and employed in accordance with the provisions of the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc.
- G. **Pipe Bedding:** Storm drainage pipe shall be laid on a bed of granular material except when a concrete encasement situations occurs. All pipe bedding material shall be Class I select granular material approved by the Engineer and shall be placed to a depth of 4 inches in an earth trench and 6 inches in a rock trench. Granular bedding shall be graded to provide for a uniform and continuous support beneath the pipe at all points. Bell holes shall be provided so that after placement, only the barrel of the pipe receives bearing pressure from the supporting material.

1. After each pipe has been aligned, and placed in final position, granular material as shown on the Drawings, shall be deposited and densified under the pipe haunches and on each side of the pipe up to the spring line of the pipe to prevent lateral displacement and hold the pipe in proper position during subsequent pipe jointing, bedding, and backfilling operations.
 2. In wet, yielding and mucky locations where the pipe is in danger of sinking below grade, the pipe must be weighted or secured permanently in place by such means as will prove effective. In areas where a high water table exists, extreme care shall be taken in the placement of the backfill material to prevent flotation of the pipe at any time.
 3. Where an unstable (i.e. water, mud, etc.) trench bottom is encountered, stabilization of the trench bottom is required. This is to be accomplished by undercutting the trench depth and replacing to grade with a foundation of aggregate material. The depth of the foundation is dependent upon the severity of the trench bottom. The size of aggregate used in the foundation will be determined by the condition of the unstable material. Once the trench bottom has been stabilized, the required Class I bedding can be placed.
- H. Special Supports: Whenever, in the opinion of the Engineer, the soil at or below the requisite pipe grade is unsuitable for supporting pipe and appurtenances specified in this Section after stabilization as herein before described, special supports shall be provided as the Engineer may direct, and the Contract sum will be adjusted.
- I. Backfilling: Backfill trenches only after pipe has been inspected, and locations of pipe lines and appurtenances, and rock excavation, if any, have been recorded. Pipes shall be backfilled as herein specified or as otherwise shown on the Drawings.
1. Initial Backfill: This backfill is defined as that material which is placed over the pipe from the spring line of the pipe, to a point 12 inches above the top of the pipe. The backfill shall be Class I aggregate material as detailed on the Drawings.
 2. Final Backfill: The trench shall be backfilled from a point 12 inches above the top of the pipe to subgrade with earth material reasonably free of any rocks. Compaction shall meet the requirements for the adjacent embankment.
 3. Walking or working on the completed pipelines, except as may be necessary in backfilling, will not be permitted until the trench has been backfilled to a point 6 inches above the top of the pipe.
 4. The Class I aggregate material used in backfilling shall be No. 9 crushed stone or clean sand meeting the requirements of the Kentucky Department of Highways.

3.04 Testing

- A. After the piping system has been brought to completion, and prior to final inspection, the Contractor shall rod out the entire system by pushing through each individual line in the system appropriate tools for the removal from the lines of any and all dirt, debris, and trash.

- B. During the final inspection, the Engineer will inspect each individual line, either by use of lights, television or other means at his disposal to determine whether the completed lines are true to line and grade as laid out or as shown on the Drawings.
1. The Engineer may require that the Contractor pass through the system under its own momentum a wooden ball of a diameter 1 inch less than the minimal diameter of the pipe, except that no ball larger than 8 inches in diameter shall be used.
 2. All lines or sections of line that are found to be laid improperly with respect to line or grade, that are found to contain broken or leaking sections of pipe, or are obstructed in such a manner that they cannot be satisfactorily corrected otherwise, shall be removed and replaced at the Contractor's expense.

3.05 Final Inspection

At the time of final inspection of the Work performed under the Contract, the storm drainage system covered by this Section shall be complete in every respect and in perfect operating condition. All surplus materials of every character resulting from the Work of this Section shall have been removed. Pipes shall be free from sand, silt, or other obstructions. Any defects discovered in the storm drainage subsequent to this inspection shall have been corrected.

3.06 Certificates

Furnish to the Engineer affidavits from the manufacturers of pipe, furnished and installed under this Section, certifying that such materials delivered to the Project conform to the requirements of this Section.

END OF SECTION

Part 1 - General

1.01 Work Included

The Contractor shall furnish all labor, material, and equipment necessary to install gravity sewer piping together with all appurtenances as shown and detailed on the Drawings and specified herein.

1.02 Related Work

- A. Section 02225 - Excavating, Backfilling, and Compacting for Utilities.
- B. Section 02735 - Manholes and Precast Sewage Structures.

Part 2 - Products

2.01 Pipe and Fittings

A. Ductile Iron (DI) Pipe:

1. Ductile iron pipe shall conform to ANSI A21.50 (AWWA C150) and ANSI A21.51 (AWWA C151) (latest revision). The pipe shall be designed for ambient atmospheric internal pressure, and external loading based on flat bottom trenches without blocks and untamped backfill laying conditions. The pipe shall have a minimum pressure class of 350 psi.
2. Fittings shall be ductile iron fittings in accordance with AWWA C153.
3. Joints shall be push-on type or mechanical joint type conforming to ANSI A21.11 (AWWA C111) or flanged joint type conforming to ANSI A21.15 (AWWA C115). Flanged joints shall only be installed in non-buried applications; otherwise, unless specifically required at designated locations by the Drawings, the type of joint used is optional.
 - a. Push-on joints shall have an annular recess in the pipe socket to accommodate a single rubber gasket. Plain ends shall be suitably beveled to permit easy entry into the bell. The gasket and annular recess of the socket shall be so designed and shaped that the gasket is located in place against displacement as the joint is assembled.
 - b. Mechanical joints shall be bolted and of the stuffing box type and shall consist of a bell with exterior flange and interior recess for the sealing gasket, a pipe or fitting plain end, a sealing gasket, a follower gland, tee-head bolts and hexagon nuts.
 - c. Flanged joints shall be bolted joints and have a thickness of Class 53. The pipe shall have a rated working pressure of 250 psi, with Class 125 flanges. Gaskets shall be ring gaskets with a thickness of 1/8-inch. Flange bolts shall

conform to ANSI B16.1. Flanged fittings shall meet all the requirements of ANSI A21.10 or A21.53 for compact fittings (AWWA C110), and have Class 125 flanges. Fittings shall accommodate a working pressure of 250 psi and be supplied with all accessories.

4. All ductile iron pipe and fittings shall have the manufacturer's outside asphaltic coating and a cement lining and bituminous seal coat on the inside. Cement mortar lining and bituminous seal coat inside shall conform to ANSI A21.4 (AWWA C104).
5. Pipe shall be furnished in lengths of 16, 16.5, 18, 19, and 20 feet nominal laying lengths. The weight of any single pipe shall not be less than the tabulated weight by more than 5 percent for pipe 12 inches or smaller in diameter, not by more than 4 percent for pipe larger than 12 inches in diameter.
6. The net weight, class or nominal thickness and sampling period shall be marked on each pipe. The pipe shall also be marked to show that it is ductile iron.
7. Pipe shall be as manufactured by U.S. Pipe & Foundry Company, American Cast Iron Pipe Company, or equivalent.

B. Polyvinyl Chloride (PVC) Pipe:

1. Solid Wall PVC Pipe (SDR 35):
 - a. PVC pipe and fittings less than 15 inches in diameter shall conform to the requirements of ASTM Standard Specifications for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings, Designation D 3034. Pipe and fittings shall have a minimum cell classification of 12454B or 12454C as defined in ASTM D-1784. All pipe shall have a pipe diameter to wall thickness ratio (SDR) of a maximum of 35.
 - b. PVC pipe and fitting with diameters 18-inch through 27-inch shall conform to the requirements of ASTM D-1784 and ASTM F-679. Pipe and fittings shall have a minimum cell classification of 12454C. The minimum wall thickness shall conform to T-1 as specified in ASTM F-679.
 - c. Joints shall be push-on bell and spigot type using elastomeric ring gaskets conforming to ASTM D 3212 and F 477. The gaskets shall be securely fixed into place in the bells so that they cannot be dislodged during joint assembly. The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial wastes, including oils and groundwater, and which will endure permanently under the conditions of the proposed use.
 - d. Pipe shall be furnished in lengths of not more than 13 feet. The centerline of each pipe section shall not deviate from a straight line drawn between the centers of the openings at the ends by more than 1/16 inch per foot of length.
 - e. PVC pipe shall not have a filler content greater than ten percent (10%) by weight relative to PVC resin in the compound.

- f. PVC pipe shall be clearly marked at intervals of 5 feet or less with the manufacturer's name or trademark, nominal pipe size, PVC cell classification, the legend "Type PSM SDR 35 PVC Sewer Pipe" and the designation "ASTM D 3034", or "ASTM F-679". Fittings shall be clearly marked with the manufacturer's name or trademark, nominal size, the material designation "PVC", "PSM" and the designation "ASTM D 3034", or "ASTM F-679".
 - g. PVC pipe shall have a minimum pipe stiffness of 46 psi for each diameter when measured at 5 percent vertical ring deflection and tested in accordance with ASTM D-2412.
 - h. Five (5) copies of directions for handling and installing the pipe shall be furnished to the Contractor by the manufacturer at the first delivery of pipe to the job. PVC pipe installation shall conform to ASTM D-2321 latest revision.
 - i. Pipe shall be as manufactured by J&M Pipe Company, or equivalent.
2. Heavy Wall PVC Pipe (SDR 26):
- a. PVC pipe and fittings shall conform to the requirements of ASTM Standard Specifications for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings, Designation D 3034. All pipe shall have a diameter to wall thickness ratio (SDR) of a maximum of 26.
 - b. Joints shall be push-on bell and spigot type using elastomeric ring gaskets conforming to ASTM D 3212 and F 477 or F 913. The gaskets shall be securely fixed into place in the bells so that they cannot be dislodged during joint assembly. The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial wastes, including oils and groundwater, and which will endure permanently under the conditions of the proposed use.
 - c. Pipe shall be furnished in lengths of not more than 20 feet. The centerline of each pipe section shall not deviate from a straight line drawn between the centers of the openings at the ends by more than 1/16 inch per foot of length.
 - d. PVC pipe shall not have a filler content greater than ten percent (10%) by weight relative to PVC resin in the compound.
 - e. PVC pipe shall be clearly marked at intervals of 5 feet or less with the manufacturer's name or trademark, nominal pipe size, PVC cell classification, the legend "Type PSM SDR 26 PVC Sewer Pipe" and the designation "ASTM D 3034", or "ASTM F-679". Fittings shall be clearly marked with the manufacturer's name or trademark, nominal size, the material designation "PVC", "PSM", and the designation "ASTM D 3034", or "ASTM F-679".
 - f. PVC pipe shall have a minimum pipe stiffness of 115 psi for each size when measured at 5 percent vertical ring deflection and tested in accordance with ASTM D-2412.

- g. Five (5) copies of directions for handling and installing the pipe shall be furnished to the Contractor by the manufacturer at the first delivery of pipe to the job. PVC pipe installation shall conform to ASTM D-2321 latest revision.
- h. All pipe shall be provided with home marks to insure proper gasket seating.

Part 3 - Execution

3.01 Pipe Laying

- A. All pipe shall be laid with ends abutting and true to the lines and grades indicated on the Drawings. The pipe shall be laid straight between changes in alignment and at uniform grade between changes in grade. Pipe shall be fitted and matched so that when laid in the trench, it will provide a smooth and uniform invert. Supporting of pipe shall be as set out in Section 02225 and in no case shall the supporting of pipe on blocks be permitted.
- B. Before each piece of pipe is lowered into the trench, it shall be thoroughly swabbed out to insure its being clean. Any piece of pipe or fitting which is known to be defective shall not be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, it shall be removed and replaced with a satisfactory pipe or fitting without additional charge. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe and beveled to match the factory bevel for insertion into gasketed joints. Bevel can be made with hand or power tools.
- C. The interior of the pipe, as the work progresses, shall be cleaned of dirt, jointing materials, and superfluous materials of every description. When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a plywood plug fitted into the pipe bell so as to exclude earth or other material and precautions taken to prevent flotation of pipe by runoff into trench.
- D. All pipe shall be laid starting at the lowest point and installed so that the spigot ends point in the direction of flow.

3.02 Jointing

All joint surfaces shall be cleaned immediately before jointing the pipe. The bell or groove shall be lubricated in accordance with the manufacturer's recommendation. Each pipe unit shall then be carefully pushed into place without damage to pipe or gasket. All pipe shall be provided with home marks to insure proper gasket seating. Details of gasket installation and joint assembly shall follow the direction of the manufacturer's of the joint material and of the pipe. The resulting joints shall be watertight and flexible. **No solvent cement joints shall be allowed.**

3.03 Water Pipe Crossing Concrete Encasement

- A. At locations shown on the Drawings, required by the Specifications, or as directed by the Engineer, concrete encasement shall be used when the clearance between the proposed sewer pipe and any existing water pipe is 18 inches or less.

- B. Whether the proposed sewer pipe is above or below the existing water pipe, the concrete shall fully encase the sewer pipe and extend to the spring line of the water pipe. Encasement shall extend in each direction along the sewer pipe until the encased sewer pipe is 10 feet from the water pipe, measured perpendicular to the water pipe.
- C. Concrete shall be 3000 psi and shall be mixed sufficiently wet to permit it to flow between and under pipes to form a continuous bridge. In tamping the concrete, care shall be taken not to disturb the grade or line of either pipe or damage the joints.
- D. Concrete for this Work is not a separate pay item and will be considered incidental to sewer pipe installation.

3.04 Testing of Gravity Sewer Lines

- A. After the gravity piping system has been brought to completion, and prior to final inspection, the Contractor shall rod out the entire system by pushing through each individual line in the system, from manhole to manhole, appropriate tools for the removal from the line of any and all dirt, debris, and trash. If necessary during the process of rodding the system, water shall be turned into the system in such quantities to carry off the dirt, debris and trash.
- B. During the final inspection, the Engineer will require all flexible sanitary sewer pipe to be mandrel deflection tested after installation.
 - 1. The mandrel (go/no-go) device shall be cylindrical in shape and constructed with nine (9) evenly spaced arms of prongs. The mandrel dimension shall be 95 percent of the flexible pipe's published ASTM average inside diameter. Allowances for pipe wall thickness tolerances of ovality (from shipment, heat, shipping loads, poor production, etc.) shall not be deducted from the ASTM average inside diameter, but shall be counted as part of the 5 percent allowance. The contact length of the mandrel's arms shall equivalent or exceed the nominal diameter of the sewer to be inspected. Critical mandrel dimensions shall carry a tolerance ∇ 0.001 inch.
 - 2. The mandrel inspection shall be conducted no earlier than 30 days after reaching final trench backfill grade provided, in the opinion of the Engineer, sufficient water densification or rainfall has occurred to thoroughly settle the soil throughout the entire trench depth. Short-term (tested 30 days after installation) deflection shall not exceed 5 percent of the pipe's average inside diameter. The mandrel shall be hand pulled by the contractor through all sewer lines. Any sections of the sewer not passing the mandrel test shall be uncovered and the Contractor shall replace and recompact the embedment backfill material to the satisfaction of the Engineer. These repaired sections shall be retested with the go/no-go mandrel until passing.
 - 3. The Engineer shall be responsible for approving the mandrel. Proving rings may be used to assist in this. Drawings of the mandrel with complete dimensioning shall be furnished by the Contractor to the Engineer for each diameter and type of flexible pipe.
- C. The pipe line shall be made as nearly watertight as practicable, and leakage tests and measurements shall be made. All apparatus and equipment required for testing shall be

furnished by the Contractor and the cost shall be included in the unit price bid for pipe and manholes.

1. The Engineer may require the Contractor to smoke test the first section (manhole to manhole) of each size of pipe and type of joint prior to backfilling, to establish and check laying and jointing procedures. The test shall consist of smoke blown into closed-off sections of sewer under pressure and observing any smoke coming from the pipe line indicating the presence of leaks. Other supplementary smoke tests prior to backfilling may be performed by the Contractor at his option; however, any such tests shall not supplant the final tests of the completed work unless such final tests are waived by the Engineer.
 2. Where the groundwater level is more than 1 foot above the top of the pipe at its upper end, the Contractor shall conduct either infiltration tests or low pressure air tests on the completed pipeline.
 3. Where the groundwater level is less than 1 foot above the top of the pipe at its upper end, the Contractor shall conduct either exfiltration tests or low pressure air tests on the completed pipeline.
- D. Low pressure air tests shall be made using equipment specifically designed and manufactured for the purpose of testing sewer lines using low pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal pressure in the pipeline cannot exceed 8 psig.
1. The test shall be made on each manhole-to-manhole section of pipeline after placement of the backfill. The Engineer or his designated representative must be present to witness each satisfactory air test before it will be accepted as fulfilling the requirements of these Specifications.
 2. Pneumatic plugs shall have a sealing length equivalent to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
 3. Low pressure air passing through a single control panel, shall be introduced into the sealed line until the internal air pressure reaches 4 psig greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe at the time of test. However, the internal air pressure in the sealed line shall not be allowed to exceed 8 psig. When the maximum pressure exerted by the groundwater is greater than 4 psig, the Contractor shall conduct only an infiltration test.
 4. At least two minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period, the low-pressure air supply hose shall be quickly disconnected from control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig (greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe) shall not be less than that shown in the following table:

Pipe in Diameter in Inches	Minutes
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5
30 & larger	13

5. When the sewer section to be tested contains more than one size of pipe, the minimum allowable time shall be based on the largest diameter pipe in the section, and shall be the time shown in the table reduced by 0.5 minutes.
 6. Reinforced concrete pipe shall be tested in accordance with ASTM C 924 (joint testing shall be in accordance with ASTM C 1103). Test time shall be a function of pipe diameter and the length of installed line to be tested as provided in ASTM C 924.
- E. Infiltration tests shall be made after underdrains, if present, have been plugged and other groundwater drainage has been stopped such that the groundwater is permitted to return to its normal level insofar as practicable.
1. Upon completion of a section of the pipeline, the line shall be dewatered and a satisfactory test conducted to measure infiltration for at least 24 hours. The amount of infiltration, including manholes, tees and connections, shall not exceed 200 gallons per nominal inch diameter per mile of sewer per 24 hours.
- F. Exfiltration tests which subject the pipeline to an internal pressure, shall be made by plugging the pipe at the lower end and then filling the line and manholes with clean water to a height of 2 feet above the top of the sewer at its upper end. Where conditions between manholes may result in test pressures which would cause leakage at the plugs or stoppers in branches, provisions shall be made by suitable ties, braces and wedges to secure the plugs against leakage resulting from the test pressure.
1. The rate of leakage from the sewers shall be determined by measuring the amount of water required to maintain the level 2 feet above the top of the pipe.
 2. Leakage from the sewers under test shall not exceed the requirements for leakage into sewers as hereinbefore specified.
- G. The Contractor shall furnish suitable test plugs, water pumps, and appurtenances, and all labor required to properly conduct the tests. Suitable bulkheads shall be installed, as required, to permit the test of the sewer. The Contractor shall construct weirs or other means of measurements as may be necessary.

Gravity Sewers

- H. Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing the leaks and retesting as the Engineer may require without additional compensation.

- I. If in the judgement of the Engineer, it is impracticable to follow the foregoing procedures for any reason, modifications in the procedures shall be made as required and as acceptable to the Engineer, but in any event, the Contractor shall be responsible for the ultimate tightness of the line within the above test requirements.

END OF SECTION

Manholes and Precast Sewage Structures**Part 1 - General****1.01 Work Included**

- A. The Contractor shall furnish all labor, material, and equipment necessary to construct manholes for sanitary sewers, including steps, frames and covers, together with all appurtenances as shown and detailed on the Drawings and specified herein. Manhole materials shall be precast concrete as detailed on the Contract Drawings. An internal flexible rubber frame seal and where necessary, an interlocking extension or extensions, shall be used to seal the entire chimney of all sanitary manholes. The seal and extension or extensions shall extend from the frame down to the top of the cone.
- B. When and where detailed or specified, the Contractor shall furnish all labor, material, and equipment necessary to construct wetwells and valve vaults for sanitary sewer collection system or sewage treatment pump stations, including steps, cast-in place hatches, and all appurtenances as shown and detailed on the Drawings and specified herein. Wetwell and valve vault materials shall be precast concrete as detailed on the Contract Drawings.

1.02 Related Work

- A. Section 02731 - Gravity Sewers.
- B. Division 3 - Concrete.

1.03 Definitions

- A. **Standard Manhole:** Any manhole that is greater than 4 feet in depth, as measured from the invert of the manhole base at its center to the bottom of the manhole frame. A standard manhole will terminate with a manhole cone with ring and lid.
- B. **Shallow Manhole:** Any manhole that is 4 feet or less in depth, as measured in the preceding sentence. A shallow manhole will terminate in a flat top with ring and lid.
- C. **Manhole Chimney:** The cylindrical variable height portion of a manhole structure used to support and adjust the finished grade of the manhole frame. The chimney extends from the top of the cone to the base of the manhole frame.
- D. **Manhole Cone:** That portion of a manhole structure which slopes upward and inward from the barrel of the manhole to the required chimney or frame diameter.
- E. **Wetwell:** A pump station sewage containing structure constructed of pre-cast concrete components which could be used for large diameter manholes. A wetwell will terminate in a flat top with a hatch and lid cast into the cover.

- F. Valve vault: A pump station valve protection structure constructed of pre-cast concrete components which could be used for manholes. A valve vault will terminate in a flat top with a hatch and lid cast into the cover.

Part 2 - Products

2.01 Concrete Manholes - General

- A. Manholes shall conform, in shape, size, dimensions, materials, and other respects, to the details indicated on the Drawings.
1. All 4-foot diameter concrete manholes shall have precast reinforced concrete developed bases. Invert channels shall be factory constructed when the base is made. Sloping invert channels shall be constructed whenever the difference between the inlet and outlet elevation is 2 feet or less. The inverts of the developed bases shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent, within the manhole, to the centerlines of adjoining pipelines. Concrete Manholes with diameters greater than 4 feet shall have cast-in-place or plastic formed inverts which shall be installed after construction of the manhole.
 2. The concrete manhole walls (barrels and cones) shall be precast concrete sections. The top of the cone shall be built of reinforced concrete adjustment rings to permit adjustment of the frame to meet the finished surface. Minimum strength of the concrete for the precast sections shall be 4,000 psi at the time of shipment.
 3. The base section shall be monolithic for 4-foot diameter manholes. Manholes with a diameter of 5 feet or larger shall have a base slab.
 4. Manhole frames and covers shall be the standard frame and cover as indicated on the Drawings and specified hereinafter in this Section.
- B. Manholes shall be equal to that manufactured by Sherman Dixie Concrete Industries.

2.02 Concrete Wetwells and Valve Vaults - General

- A. Wetwells and valve vaults shall conform, in shape, size, dimensions, materials, and other respects, to the details indicated on the Drawings.
1. Concrete wetwells shall have cast-in-place inverts. Invert slopes shall be as depicted on the drawings or as required by the pump manufacturer.
 2. The concrete wetwell and valve vault walls (barrels) shall be precast concrete sections. The tops of both structures shall be flat, with frames and hatches cast into the slab sections. Minimum strength of the concrete for the precast sections shall be 4,000 psi at the time of shipment.

3. The base section shall be monolithic for 4-foot diameter wetwells and valve vault structures. Wetwells and valve vault structures with diameters of 5 feet or larger shall have a base slab.
- B. Precast components for wetwells and valve vaults shall be equal to that manufactured by Sherman Dixie Concrete Industries.

2.03 Precast Concrete Sections

- A. Precast concrete sections and appurtenances shall conform to the ASTM Standard Specifications for Precast Reinforced Concrete Manhole Sections, Designation C478, latest revision, with the following exceptions and additional requirements.
1. The wall sections shall be not less than 5 inches thick.
 2. Only Type II cement shall be used except as otherwise specified.
- B. Joints between sections shall be made watertight through the use of rubber O-ring gaskets or rubber profile gaskets such as Forsheda 138. Gaskets shall conform to the ASTM Standard C-443, latest revision. Rope mastic or butyl mastic sealant shall not be allowed except as sealant between the cone section, any adjusting sections or rings, and the frame casting.

2.04 Manholes Frames and Covers

- A. The Contractor shall furnish all cast-iron manhole frames and covers conforming to the details shown on the Drawings, or as specified.
1. The castings shall be of good quality, strong, tough, evengrained cast iron, smooth, free from scale, lumps, blisters, sandholes, and defects of every nature which would render them unfit for the service for which they are intended. Contact surfaces of covers and frame seats shall be machined to prevent rocking of covers.
 2. All castings shall be thoroughly cleaned and subject to a careful hammer inspection.
 3. Castings shall be at least Class 25 conforming to the ASTM Standard Specifications for Gray Iron Casting, Designation A48, latest revision.
 4. Unless otherwise specified or detailed, manhole covers shall be 22-3/4 inches in diameter, weighing not less than 350 pounds per frame and cover. Manhole covers shall set neatly in the rings, with contact edges machined for even bearing and tops flush with ring edge. They shall have sufficient corrugations to prevent slipperiness. The covers shall have two (2) pick holes about 1-1/4 inches wide and 2 inches deep with 3/8-inch undercut all around. Covers shall not be perforated.
 5. All covers shall be marked in large letters "SANITARY SEWER" in the center.
- B. Frames and covers shall be equal to J.R. Hoe and Sons, Mc-350.

2.05 Manhole Steps (Concrete Manholes)

Manholes steps shall be the polypropylene plastic type reinforced with a deformed steel rod. The steps shall be of the size and configuration as shown on the Drawings. Steps shall line up over the downstream invert of the manhole. The steps shall be embedded into the manhole wall a minimum of 3-3/8 inches. Steps shall be uniformly spaced at 12-inch to 16-inch intervals.

2.06 Pipe Connector System

- A. All holes for pipe connections in manhole and wetwell barrels and bases shall have a factory-installed flexible rubber pipe connector system to prevent infiltration. The pipe connector system shall conform to the latest revision of ASTM-C923.
- B. For manholes of 12 feet or less in depth, without the presence of ground water, the pipe connector system shall be equal to A-Lok Manhole Pipe Seal as manufactured by A-Lok Corporation, Trenton, NJ; Contour Seal or Kor-N-Seal as manufactured by National Pollution Control Systems, Inc., Nashua, NH; PSX as manufactured by Press-Seal Gasket Corporation.
- C. For manholes of 12 feet or greater in depth, or when ground water is present, the pipe connector system shall be equal to A-Lok Manhole Pipe Seal as manufactured by A-Lok Corporation, Trenton, NJ.

2.07 Polyethylene Diaphragm Manhole Frame Inserts

- A. Polyethylene diaphragm manhole frame inserts shall be installed in all manholes or those manholes which are susceptible to inflow as indicated on the Drawings.
 - 1. Polyethylene diaphragm manhole frame inserts shall be manufactured from corrosion-proof material suitable for atmospheres containing hydrogen sulfide and diluted sulfuric acid.
 - 2. The body of the manhole insert shall be made of high density polyethylene copolymer material meeting ASTM Specification D 1248, Class A, Category 5, Type III (the insert shall have a minimum impact brittleness temperature of -180 degrees Fahrenheit). The thickness shall be a uniform 1/8 inch or greater. The manhole frame insert shall be manufactured to dimensions as shown on the Drawings to allow easy installation within the manhole frame.
 - 3. Insert gaskets shall be made of closed cell neoprene. The gasket shall have a pressure sensitive adhesive on one side and shall be placed under the weight bearing surface of the insert by the manufacturer. The adhesive shall be compatible with the manhole insert material so as to form a long-lasting bond in either wet or dry conditions.

4. A lift strap shall be attached to the rising edge of the bowl insert. The lift strap shall be made of 1 inch wide woven polypropylene web and shall be seared on all cut ends to prevent unraveling. The lift strap shall be attached to the manhole insert by means of a stainless steel rivet. Placement of the lift strap shall provide easy visual location.
 5. Standard ventilation shall be by means of vent hole on the side wall of the manhole frame insert approximately 3/4-inches below the lip. The vent hole will allow a maximum release of 10 gallons per 24 hours when the insert is full.
 6. The manhole frame insert shall be manufactured to fit the manhole frame rim upon which the manhole cover rests. The Contractor is responsible for obtaining specific measurements of each manhole cover to insure a proper fit. The manhole frame shall be cleaned of all dirt, scale and debris before placing the manhole frame insert on the rim.
- B. The polyethylene diaphragm manhole inserts shall be as provided by any manufacturer approved by the Engineer.

2.08 Manhole Frame Seal

- A. Manhole frame seals shall consist of a flexible internal rubber sleeve and extension and stainless steel compression bands, all conforming to the following requirements:
1. Rubber Sleeve and Extension - The flexible rubber sleeve, extensions and wedge strips shall be extruded or molded from a high grade rubber compound conforming to the applicable requirements of ASTM C-923, with a minimum 1500 psi tensile strength, maximum 18% compression set and a hardness (durometer) of 48_5.
 2. The sleeve shall be either double or triple pleated, with a minimum unexpanded vertical height of 8 inches and 10 inches respectively and a minimum thickness of 3/16 inches. The top and bottom section of the sleeve shall contain an integrally formed expansion band recess and multiple sealing fins.
 3. The top section of the extension shall have a minimum thickness of 3/32 inches and shall be shaped to fit into the bottom band recess of the sleeve under the bottom chimney seal band and the remainder of the extension shall have a minimum thickness of 3/16 inches. The bottom section of the extension shall contain an integrally formed expansion band recess and multiple sealing fins matching that of the rubber sleeve.
 4. Any splice used to fabricate the sleeve and extension shall be hot vulcanized and have a strength such that the sleeve shall withstand a 180 degree bend with no visible separation.
 5. The continuous wedge strip used to adapt the rubber sleeve to sloping surfaces shall have the slope differential needed to provide a vertical band recess surface, be shaped to fit into the band recess and have an integral band restraint. The length of the wedge strip shall be such that, when its ends are butted together, it will cover the entire inside circumference of that band recess needing slope adjustment.

6. The expansion bands used to compress the sleeve against the manhole shall be integrally formed from 16 gauge stainless steel conforming to ASTM A-240 Type 304, with no welded attachments and shall have a minimum width of 1: inches. The bands shall have a minimum adjustment range of 2 diameter inches and the mechanism used to expand the band shall have the capacity to develop the pressures necessary to make a watertight seal. The band shall be permanently held in this expanded position with a positive locking mechanism, any studs and nuts used for this mechanism shall be stainless steel conforming to ASTM F-923 and 594, Type 304.

- B. Manhole frame seals shall be equal to that manufactured by Cretex Specialty Products.

2.09 Cleanouts

- A. Cleanouts shall be extended to finish grade and capped with a clean-out plug in accordance with details and at locations shown on the Drawings.
 1. Pipe shall be the same as the gravity sewer line in which the cleanout is located.
 2. A 4-inch thick concrete pad, 2 feet 0-inches square, with the cleanout lid section, shall be provided around each cleanout.

2.10 Drop Connections

Drop connections shall be installed in the manhole as shown on the Drawings.

Part 3 - Execution

3.01 Fabrication – Precast Sections

- A. Manhole and valve vault sections shall contain manhole steps accurately positioned and embedded in the concrete when the section is cast. Wet well sections shall contain no manhole steps.
- B. Sections shall be cured in an enclosed curing area and shall attain a strength of 4,000 psi prior to shipment.
- C. No more than two (2) lift holes or inserts may be cast or drilled in each section.
- D. Flat slab tops shall have a minimum thickness of 6 inches and reinforcement in accordance with ASTM C478.
- E. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the precast sections.
- F. Acceptance of the sections will be on the basis of material tests and inspection of the completed product and test cylinders if requested by the Engineer.
- G. Cones shall be precast sections of similar construction.

3.02 Setting Precast Sections

- A. Precast reinforced concrete sections shall be set so as to be vertical and with sections and steps, where required, in true alignment.
- B. Rubber gaskets shall be installed in all section joints in accordance with the manufacturer's recommendations.
- C. All holes in sections used for their handling shall be thoroughly plugged with rubber plugs made specifically for this purpose.

3.03 Setting Manhole Frames and Covers

- A. Manhole frames shall be set with the tops conforming to the required elevations set forth hereinbefore. Frames shall be set concentric with the top of the concrete and in a full bead of butyl mastic sealant so that the space between the top of the manhole and the bottom flange of the frame shall be completely watertight.
- B. Manhole covers shall be left in place in the frames on completion of other work at the manholes.

3.04 Installation of Manhole Frame Seal

- A. The Contractor shall measure the manhole to determine the information required on the manufacturer's Sizing and Ordering procedure.
 - 1. All sealing surfaces shall be reasonably smooth, clean and free of any form offsets or excessive honeycomb. The top internal portions of the cone shall have a minimum 3-inch high vertical surface. The preparation of this vertical surface when none exists shall be in accordance with the frame seal manufacturer's instructions.
 - 2. The internal frame seals and extensions shall be installed in accordance with the manufacturer's instructions. The Contractor shall have a manufacturer's recommended expansion tool and all other equipment/tools necessary to install the frame seals.
 - 3. Manhole frame seals shall be visually inspected after installation to ensure that the seal is properly positioned, tight against the manhole and frame surfaces, that no voids or leakage points exist and that the bands are securely locked in place. Any seals failing this inspection shall be reworked as necessary and reinspected at no additional cost to the Owner.

3.05 Adjusting Manhole Frames and Covers to Grade

- A. Unless otherwise shown on the Drawings, the top of the precast concrete eccentric cone of a standard manhole or the top of the flat slab of a shallow manhole shall terminate not less than 4 inches below existing grade in an unpaved non-traffic area (except in a residential yard) and not less than 13 inches below existing grade in a paved or unpaved traffic area and in a residential yard. The frame and lid shall be adjusted to the required final grade as described hereinafter.
- B. Only clean adjusting sections shall be used. Each adjusting section shall be laid in a bead of butyl mastic sealant and shall be thoroughly bonded.
- C. When a manhole is located in an unpaved non-traffic area (other than a residential yard), the frame and cover shall be adjusted to a final elevation of 3 inches to 5 inches above the existing grade at the center of the cover. If field changes have resulted in the installed manhole invert elevation being lower than the invert elevation shown on the Drawings, the adjustment to the required final elevation of 3 inches to 5 inches above existing grade shall be accomplished by the use of precast concrete adjusting rings. If field changes have resulted in the completed manhole invert being higher than the invert shown on the Drawings and the top of the frame and cover being higher than 5 inches above the existing grade, then the Contractor shall substitute, at no additional cost to the Owner, a shorter barrel section on the manhole so that the frame and lid may be adjusted to the proper final elevation through the use of precast concrete adjusting rings.
- D. When a manhole is located in a bituminous, concrete, or crushed stone traffic area, or in a residential yard, the frame and cover shall be adjusted to the grade of the surrounding area by the use of precast concrete rings. The adjusted frame and lid shall conform to the elevation and slope of the surrounding area. If field changes have resulted in the completed manhole invert being higher than the invert shown on the Drawings and the top of the eccentric cone, when used, or the top of the flat slab, when used, being less than the height of the frame and lid below the grade of the surrounding area, then the Contractor shall substitute, at no additional cost to the Owner, a shorter barrel section on the manhole so that the frame and lid may be adjusted to the proper final elevation through the use of precast concrete adjusting rings.
- E. The Contractor shall coordinate elevations of manhole covers in paved streets with the Owner. If resurfacing of the street in which sewers are laid is expected within twelve (12) months, covers shall be set 1-1/2 inches above the existing pavement surface in anticipation of the resurfacing operations.

3.06 Vacuum Testing of Manholes and Precast Sewage Structures

- A. Manholes shall be tested in accordance with ASTM 1244, after installation with all connections in place. The vacuum test method is intended to demonstrate the condition of manholes prior to backfill. It may also be used to test manholes after backfilling; however, testing should be correlated with the connector supplier.

- B. Where groundwater is present in the excavation and trenches, the Contractor shall take any necessary steps (including construction of a piezometric tube adjacent to the manhole) to determine the depth of groundwater above the invert of the manhole at the time of testing, at no additional cost to the Owner. Information concerning groundwater levels above the invert shall be used to determine the amount of vacuum applied during the test.
- C. A vacuum test for manholes **shall** include testing of the joint seal between the cast iron frame and the concrete cone, top slab, and any grade rings. Where a hatch and cover are provided in the top of a precast sewage structure, the Contractor shall provide a means of establishing a seal over the hatch, unless the Drawings and notes indicate that the hatch is to be tested for vacuum.
- D. Prior to the test, the following items shall be complete:
1. Lift holes, if any, shall be plugged with an approved, non-shrink grout prior to testing.
 2. Drop connections, if any, shall be installed prior to testing.
- E. Testing Procedure:
1. Temporarily plug, with the plugs being braced to prevent the plugs or pipes from being drawn into the manhole, all pipes entering the manhole at least eight inches into the sewer pipe(s). The plug must be inflated at a location past the manhole/pipe gasket.
 2. The test head shall be placed on the top of the conical, over the manway opening in a flat top, or (in the case of a wetwell or valve vault) over such adapter as may be required, and inflated in accordance with the manufacturer's recommendations.
 3. A vacuum of 10 inches of mercury shall be drawn on the manhole, or such lesser amount of vacuum that the combined vacuum and positive external head pressure from groundwater does not exceed the recommended pressure ratings for the pipe connector system. The vacuum shall be measured by a test gauge which shall be liquid filled, having a 3.5 inch diameter face, reading from zero to thirty inches of mercury.
 4. The indicated vacuum (as determined under the preceding paragraph) shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop 1 inch of mercury.

5. The manhole shall be considered to pass the vacuum test if the time for the vacuum reading to drop 1 inch of mercury meets or exceeds the values indicated in the following table:

Minimum Test times for Various Manhole Diameters (seconds)									
Depth (ft.)	Diameter (inches)								
	30	33	36	42	48	54	60	66	72
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	28	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	58	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	69	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

6. If a manhole fails the vacuum test, the manhole shall be repaired with a non-shrinkable grout or other suitable material based on the material of which the manhole is constructed and retested, as stated above.
7. Failure of this vacuum test shall not preclude acceptance by appropriate water infiltration or exfiltration testing, or such other means as may be accepted by the Engineer.
8. All temporary plugs and braces shall be removed after each test.

END OF SECTION

Chain Link Fence and Gates

Part 1 - General

1.01 Work Included

- A. The Contractor shall furnish and erect chain link fencing and gates as indicated on the Drawings and as herein specified.
- B. Chain link fence shall have a top rail and bottom tension wire, and three (3) strands of barbed wire projecting outward at the top.
- C. Chain link fence materials and installation shall meet or exceed the standards of the Chain Link Fence Manufacturers Institute, New York, NY, except as otherwise specified in this Section. Fence materials shall meet or exceed Federal Specification RR-F-191H/GEN for fencing, wire and post metal (gates, chain link fence fabric, and accessories), and shall conform to the ASTM Standard Specifications hereinafter noted.
- D. Fence framework, fabric, and accessories.
- E. Excavation for post bases.
- F. Concrete anchorage for posts.
- G. Manual gates and related hardware.

1.02 Related Work

Division 3 - Concrete.

1.03 References

- A. ANSI/ASTM A123: Zinc (hot-dip galvanized) coatings on iron and steel products.
- B. ANSI/ASTM F567: Installation of chain link fence.
- C. ASTM F1083: Pipe, steel, hot-dipped zinc-coated (galvanized) welded, for fence structures.
- D. ASTM C94: Ready-mixed concrete.
- E. FS RR-F-191: Fencing, wire, post, and metal.

1.04 Quality Assurance

- A. Manufacturer: Company specializing in commercial quality chain link fencing with not less than two (2) years of experience.
- B. Installation: ANSI/ASTM F567.

1.05 Submittals

- A. Submit shop drawings and product data under provisions of Section 01340.
- B. Include plan layout, grid, spacing of components, gates, accessories, fittings, hardware, anchorages, and schedule of components.
- C. Submit manufacturer's installation instructions under provisions of Section 01340.

Part 2 - Products

2.01 Materials

Framework: ASTM F1083; Schedule 40 steel pipe, standard weight, one (1) piece without joints.

2.02 Concrete Mix

Concrete shall be accordance with Division 3.

2.03 Materials

- A. All ferrous metal fittings, posts, fence and gate framework, and all accessories shall be galvanized with a heavy coating of 2.0 ounces pure zinc spelter per square foot of surface area to be coated using the hot-dip process. Thinner zinc coatings and electro-galvanizing will not be used as a substitute for the specified hot-dip galvanized finish.
- B. All fabrication and welding shall be done before hot-dip galvanizing. All welding shall conform to the American Welding Society standards.
- C. The chain link fence fabric shall be galvanized steel chain link fabric conforming to ASTM Standard Specification for zinc-coated steel chain link fence fabric, Designation A392, with Class 2 zinc coating (2.0 ounces of zinc per square foot of uncoated wire surface). The fabric shall be woven in 2-inch mesh from No. 9 gage wire in a 7-foot width with barbed selvages top and bottom.
- D. The barbed wire shall be galvanized steel barbed wire consisting of two (2) strands of twisted No. 12 1/2-gage wires with 4-point barbs spaced 3 inches apart and conforming to ASTM Standard Specification of zinc-coated (galvanized) steel barbed wire, Designation A121, with Class 3 zinc coating (minimum of 0.80 ounces of zinc per square foot of uncoated wire surface for No. 12 1/2-gage wire).
- E. The tension wire shall be No. 7 gage coil spring steel wire with galvanized finish having minimum of 0.80 ounces of zinc coating per square foot of uncoated wire surface.
- F. Tie wires for fastening fence fabric to line posts and rails shall be not less than No. 6 gage aluminum wire.

- G. Line posts shall be 2-3/8 inches outside diameter steel pipe weighing not less than 3.65 pounds per foot, or 1-7/8 inches high carbon steel H-beams weighing not less than 2.70 pounds per foot.
- H. End, corner, and pull posts shall be 3 inches outside diameter steel pipe weighing not less than 5.79 pounds per foot, or 2-1/2 inches square steel tube weighing not less than 5.14 pounds per foot, or 3-1/2 inches roll-formed, steel corner section weighing not less than 5.14 pounds per foot.
- I. Gate posts for a gate leaf up to and including 6-foot wide, shall be 3 inches outside diameter steel pipe weighing not less than 5.79 pounds per foot or 3-1/2 inches by 3-1/2 inches roll-formed, steel corner section weighing not less than 5.14 pounds per foot.
- J. Gate posts for a gate leaf over 6-foot wide, including 13 feet wide shall be 4 inches outside diameter steel pipe weighing not less than 9.10 pounds per foot.
- K. Top railings and railing for top, middle and bottom braces between terminal posts and adjacent line posts shall be 1-5/8 inch outside diameter steel pipe weighing not less than 2.27 pounds per foot, or 1-5/8 inches by 1-1/4 inches, 14 gage roll-form section.
- L. Diagonal truss braces between terminal and adjacent line posts and for gate framework shall be 3/8-inch diameter steel rod.
- M. Barbed wire support arms shall project outward from the top of the posts at 45 degrees and shall be capable of withstanding a 200-pound downward pull on the outermost end of arm, without failure. The arms shall have provision for the attachment of three (3) strands of evenly spaced barbed wire. Arms shall be integral with post top weather caps having holes for the passage of the top trail at intermediate posts.
- N. Fittings shall be heavy duty malleable iron or pressed steel of suitable size to produce strong construction.
- O. Stretcher bars for attaching fabric to terminal posts such as end, corner, pull, or gate posts and gate frames shall be flat bars with minimum cross-section dimensions of not less than 1/4-inch by 3/4-inch. The stretcher bars shall be the full height of the fabric and shall be secured with bar bands of not less than 11 gage sheet steel, spaced approximately 15 inches on centers and bolted with 3/8-inch diameter bolts.
- P. Gate leaf framework shall be 1-7/8 inches outside diameter steel pipe weighing not less than 2.72 pounds per foot.
- Q. If bolted or riveted corner fittings are not used, the gate frame shall be hot-dip galvanized after welding.
- R. Gate hinges shall be of heavy pattern of adequate strength for the gate size, with large bearing surfaces for clamping or bolting in position.
- S. The gates shall be provided with a suitable latch accessible from both sides and with provision for padlocking.

- T. Double leaf swing gates shall have a center bolt, center stop, and automatic backstops to hold leaves in open position.
- U. Gate padlocks shall have solid brass cases, hardened steel shackles, removable core cylinders, and galvanized steel chains attached to the shackle by a clevis. Padlocks shall be manufactured by Eaton Corporation Lock & Hardware Division, of Emhart Corporation, Berlin, CT; Best Universal Lock Company, Inc., Indianapolis, IN; or approved equivalent. The padlocks shall be furnished with two (2) keys each and keyed to the pattern provided by the Owner.

2.04 Finishes

- A. Galvanized: ANSI/ASTM A123; 2.0 ounce per square foot coating.
- B. Accessories: Same finish as framing and fabric.

Part 3 - Execution

3.01 Installation

- A. The fence and gates shall be erected by skilled mechanics.
- B. Post spacing shall be uniform with maximum spacing of 10 feet in fences erected along straight lines. All posts shall be placed plumb and centered in the concrete foundations.
- C. Post foundations in earth shall be concrete cylinders with a minimum diameter of 12 inches greater than the post diameter set in the foundation, crowned at grade to shed water, and shall not be less than 36 inches deep in the ground. Posts shall be set in the full depth of the foundations except for 3 inches of concrete under the posts.
- D. If foundation holes are excavated in peat or other unstable soil, the Engineer shall be notified for determination of suitable construction precautions.
- E. If solid ledge is encountered without overburden of soil, posts shall be set into the rock a minimum depth of 12 inches for line posts and 18 inches for terminal posts. Post holes shall be at least 1 inch greater in diameter than the post, and the grout shall be thoroughly worked into the hole so as not to leave voids, and shall be crowned at the top to shed water. Where solid rock is covered by an overburden, the total setting depths shall not exceed the depths required for setting in earth, and the posts shall be grouted into the rock as described.
- F. Any change in direction of the fence line of 20 degrees or more shall be considered corners. Pull posts shall be used at any abrupt change in grade.
- G. Maximum area of unbraced fence shall not exceed 1,500 square feet.
- H. Terminal posts shall be braced to adjacent posts with horizontal brace rails and diagonal truss rods brought to proper tension so that posts are plumb.

- I. There shall be no loose connections or sloppy fit-up in the fence framework. The fence framework shall withstand all wind and other forces due to the weather.
- J. Fabric shall be stretched taut and tied to posts, rails and tensions wires with the bottom edge following the finished grade not more than 2 inches above the grade. The fabric shall be installed on the security side of the fence and shall be anchored to the framework so that the fabric remains in tension after pulling force is released. The fabric shall be attached to line posts with ties spaced at not more than 15-inch intervals and to rails and braces at no more than 24-inch intervals. The fabric shall be attached to the tension wire with hog ring ties on 24-inch centers.
- K. Three (3) strands of barbed wire shall be installed on each extension arm of the line fence and at the top of each gate. The wires shall be pulled taut and fastened at each support.
- L. Gates shall be installed plumb, level, and secure for the full width of the opening and the hardware adjusted for smooth operation. Provide concrete center drop to foundation depth and drop rod retainers at center of double gate openings.

END OF SECTION

Part 1 - General

1.01 Work Included

Chain-link cantilever slide gates with enclosed aluminum track and hardware.

1.02 Related Sections

- A. Section 02830 - Chain Link Fences and Gates.
- B. Section 02835 - Gate Operators
- C. Division 3 - Cast-In-Place Structural Concrete

1.03 Submittals

- A. Shop drawings: Layout of fences and gates with dimensions, details, and finishes of components, accessories, and post foundations.
- B. Product Data: Manufacturer's catalog cuts indicating material compliance and specified options.
- C. Samples: Color selections for Polyolefin finishes. If requested, samples of materials (e.g., fabric, wires and accessories).

1.04 Warranty

Provide manufacturer's standard limited warranty covering cantilever slide gate and truck assembly against failure resulting from normal use for period of 5 years from date of purchase. Failure shall be defined as any defect in manufacturing that prevents the gate from operating in a normal manner.

Part 2 - Products

2.01 General

- A. Products from qualified manufacturers having a minimum of 5 years experience manufacturing internal roller cantilever slide gate will be acceptable if they meet all of the following specifications for design, size gauge of metal parts and fabrication.

2.02 Chain Link Cantilever Slide Gates

- A. Gate Frames: Fabricate chain link cantilever slide gates in accordance with ASTM F 1184, Type II, Class 2, using minimum 2-inch square aluminum members. ASTM B 221, alloy and temper 6063-T6, weighing not less than 0.94 lb/ft. Weld members together

Chain Link Cantilever Slide Gate

forming rigid one-piece frame integral with top track (no substitution). Provide not less than 10 truck assemblies for each gate.

Weld an additional 2-inch square lateral support rail adjacent to top horizontal rail. Bottom rail shall consist of 2-inch x 4-inch aluminum member weighing not less than 1.71 lb/ft.

<u>Gate Actual Opening Sizes</u>	<u>Cantilever Support (Overhang)</u>
12 ft	10'-0"
14 ft to 16 ft	12'-0"
18 ft to 24 ft	12'-0"

- B. Gate frame Finish: Natural Aluminum (Other; Specify)
- C. Chain Link Filler Finish: Aluminized - ASTM A 491 Mesh, and gauge to match fence. Install fabric with hook bolts and tension bars at all 4 sides. Attach to gate frame at not more than 15 inches on center.
- D. Bracing: Provide diagonal adjustable length truss rods of 3/8-inch galvanized steel, in each panel of gate frames.
- E. Top track/rail: Enclosed combination one-piece track and rail, aluminum extrusion with weight of 4.66 lb/ft. Track shall be capable of withstanding a reaction load of 2,000 lb.
- F. Truck assembly: Swivel type, zinc die cast, with 4 sealed lubricant ball-bearing rollers, 2-inches in diameter by 9/16-inch in width, and two side rolling wheels to ensure truck alignment in track. Mount trucks on post tracks using 7/8-inch diameter ball bolts with 1/2-inch shank. Truck assembly shall be capable of withstanding the same reaction load as track (2,000 lb).
- G. Gate hangers, latches, brackets, guide assemblies, and stops: Malleable iron or steel, galvanized after fabrication. Provide positive latch with provisions for padlocking.
- E. Bottom guide wheel assemblies: Each assembly shall consist of two, 3-inch diameter rubber wheels, straddling bottom horizontal gate rail, allowing adjustment to maintain gate frame plumb and in proper alignment. Attach one assembly to each guide post.

2.06 Setting Materials

Concrete: Minimum 28-day compressive strength of 4,500 psi.

Part 3 - Execution

3.01 Examination

- A. Verify areas to receive fencing are completed to final grades and elevations.

- B. Inspect areas to assure sufficient space to receive gate in open position (gate and overhang).
- C. Ensure property lines and legal boundaries of work are clearly established, if gate is located as a property boundary.

3.02 Chain Link Fence and Gatepost Installation

- A. Install chain link fence in accordance with manufacturer's instructions.
- B. Concrete-set gateposts: Drill holes in firm, undisturbed or compacted soil. Holes shall have a minimum diameter of four times (4x) greater than the outside dimension of post, and depth of approximately 6-inches deeper than post bottom. Installer shall excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom a minimum of 36-inches below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour. Trowel finish around post. Slope to direct water away from posts.

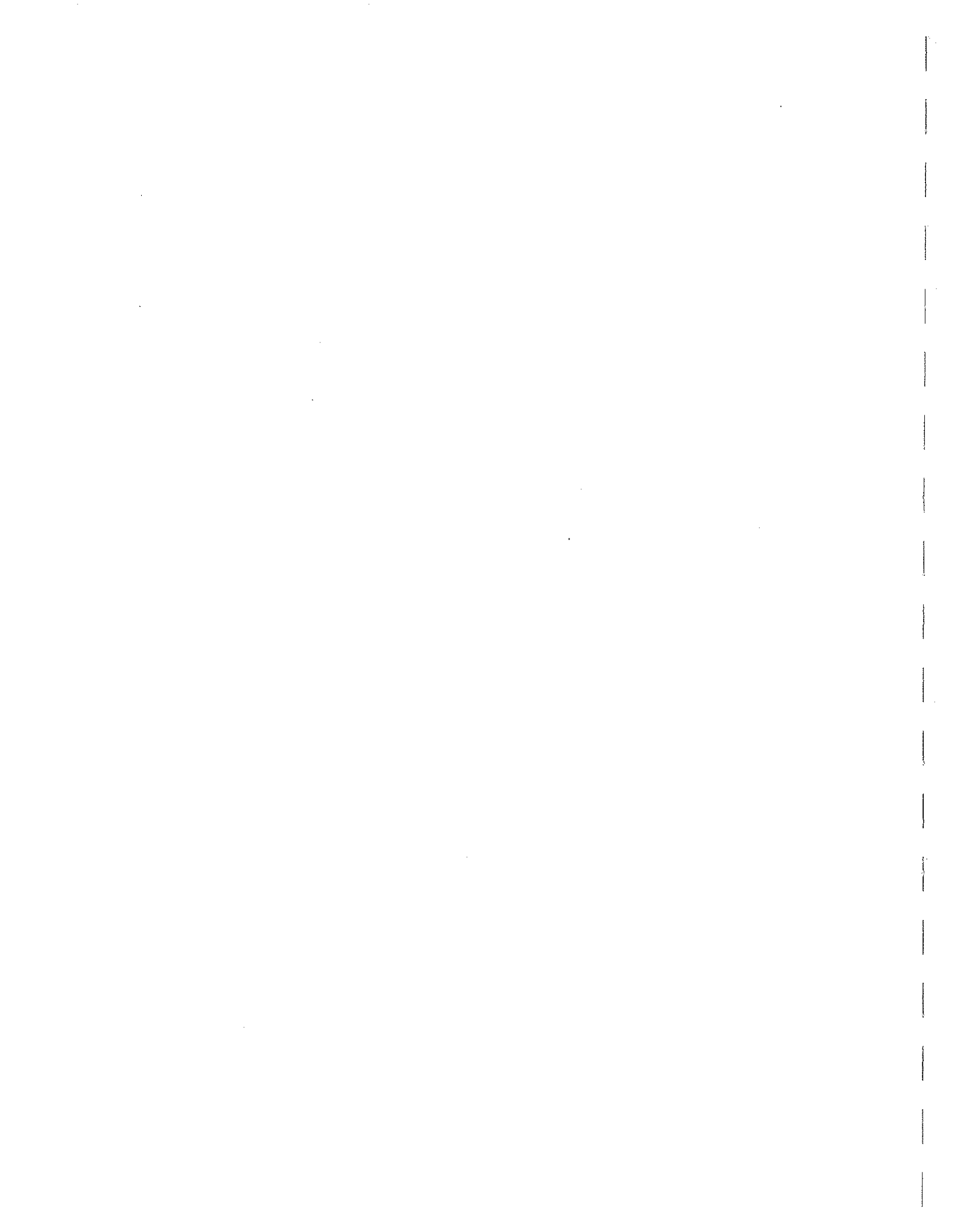
3.03 Gate Fabric Installation

- A. Fabric: Install fabric on security side and attach so that fabric remains in tension after pulling force is released. Leave approximately 2-inches between finish grade and bottom selvage. Attach fabric with wire ties to line posts at 15-inches, on center and to rails, braces, and tension wire at 24-inches on center.
- B. Tension (stretcher) bars: Pull fabric taut; thread tension bar through fabric and attach to terminal posts with bands or clips spaced maximum of 15-inches on center.

3.04 Cleaning

Clean up debris and unused material, and remove from the site.

END OF SECTION



Cantilever Slide Gate Operator

Part 1 General

1.01 Work Included

- A. Sliding Gate Operators.
- B. Gate Control Equipment.

1.02 Related Section

- A. Section 02830 - Chain Link Fences and Gates.
- B. Section 02833 - Chain Link Cantilever Slide Gate.
- C. Division 3 - Cast-In-Place Structural Concrete.
- D. Division 16 - General Provisions.

1.03 Quality Assurance

Upon completion of installation, check equipment and components to ensure proper and safe function; correct any defects or deficiencies.

1.04 Submittals

- A. Printed instructions, installation procedures, and details of equipment.
- B. Cut sheets for components, materials, colors, attachments, and fittings.
- C. UL325, I, II, III & IV Listings.

Part 2 - Products

2.01 Materials

Obtain operators and gates, including accessories, fittings, and fastenings, from a single

2.02 Operator

- A. Electric gate operator:
 - 1. Gate to be operated by an electric or hydraulic motor operator. All components of the manual override shall be securely enclosed and locked in a 10-gauge steel enclosure.

Cantilever Slide Gate Operator

2. Motive power, either direct drive or hydraulic pump, shall be supplied by 1 HP B 115volt - single phase motor. Operator shall be tested to UL 325 standards.
3. Limit switches shall be readily adjustable with normal hand tools, and securely locked in place after adjustment B switch contacts shall be rated not less than 6 amps.
4. Spring-loaded friction feed type drive mechanism, consisting of two drive wheels, a manual toggle-style disconnect to instantly disengage the drive wheels for manual operation.
5. Gate operating speed B 1.2 fps.
6. Drive rail shall be 6061-T6 aluminum, not less than 3/16-inch thick.

2.03 Access Control Equipment

A. Gate Operator Control Systems:

1. External Obstruction Sensing
2. Obstruction Sensing Alarm Master/Slave Operation (required for double gates)
3. Gate Movement Warning
4. Delay on Reverse
5. Limit Switches- Proximity Limit Switches not affected by ice or snow
6. Automatic Shut Down
7. Timer to Close
8. Power Train Disconnect
9. On/Off Switch

B. Access and Exit Systems:

1. Stand-alone Digital keypad, HID compatible.
2. Intercom for voice communication.
3. Hardwired detection device for "free exit"

2.04 Gate Safety

- A. Gate edges to reverse or stop the gate.
- B. Magnetic vehicle detectors.
- C. Audible warning of gate operation.

Part 3 - Execution

3.01 Examination

Make field measurements and verify locations before installation.

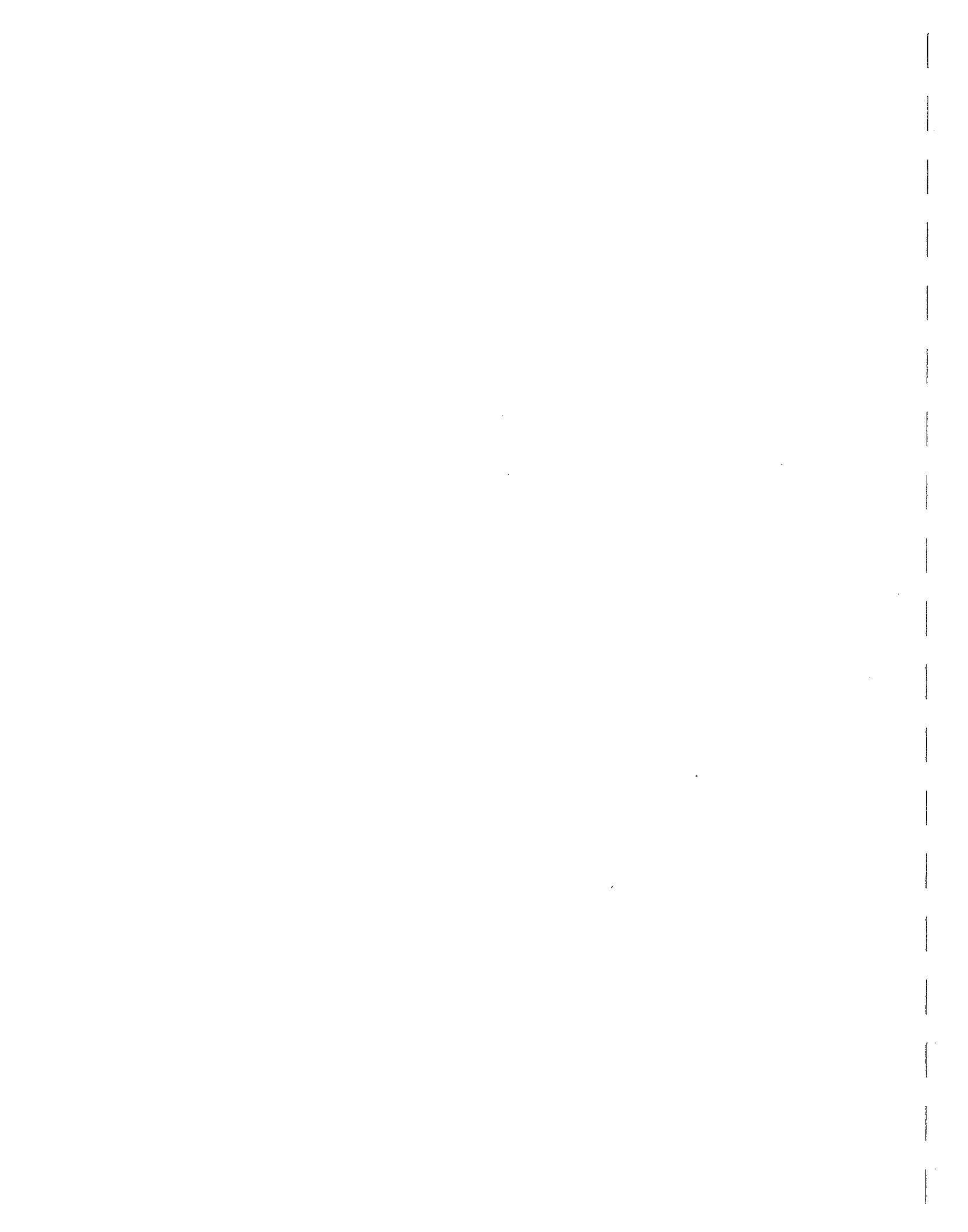
3.02 Installation

- A. Install in a workmanlike manner in conformance with manufacturer's printed instructions and details.
- B. Anchor or install electric operator on a concrete foundation.
- C. Have at least 2 years previous experience in gate operator installations.
- D. Provide field drawings showing layout and locations for all equipment that is being supplied.
- E. Electrician shall perform all electrical connections.
- F. Electrical power to gate operator and controls shall be provided through a dedicated circuit breaker.

3.01 Cleaning

Clean up debris and unused material, and remove from the site.

END OF SECTION



Part 1 - Work Included

1.01 Clean-Up

Upon completion of the Project, the Contractor shall remove all debris and surplus construction materials resulting from his work. The Contractor shall grade the ground along each side of the pipe trenches and/or structures in a uniform and neat manner leaving the construction area in a shape as near as possible to the original ground line, or as shown on the Drawings.

Part 2 - Products

2.01 Seed

Grass seed shall be mixed and guaranteed by the supplier to consist of the following:

Annual Rye	60 percent
Kentucky Bluegrass	20 percent
Falcon Fescue	20 percent

2.02 Topsoil

Topsoil shall be material stripped and stored. If the quantity of stored topsoil is inadequate or if none has been salvaged from the Project site, the Contractor shall furnish at his own expense sufficient topsoil to properly install all work as specified herein.

Topsoil shall be original surface loam obtained from well drained areas from which topsoil has not been removed previously, either by erosion, clearing and removal of trees or mechanical means. It shall not contain subsoil material and shall be clean and free of clay lumps, roots, stones or similar substances more than 2 inches in any dimension, debris, discarded fragments of building materials or weeds and weed seeds.

2.03 Soil Improvements

- A. Commercial fertilizers shall be of analyses specified, or as recommended by the Agricultural Extension Service for treatment of topsoil in the area from which removed, and shall conform to the applicable state fertilizer laws. Fertilizer shall be uniform in composition, dry and free flowing, and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis. Any fertilizer which becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted.
- B. Lime, if recommended for soil treatment by the Agricultural Extension Service, shall be ground limestone (Dolomite) containing not less than 85 percent of total carbonates, and shall be ground to such a fineness that 50 percent will pass through a 100-mesh sieve, and 90 percent will pass through a 20-mesh sieve. Coarser material shall be acceptable.

Seeding

provided that required rates of application are increased proportionally on the basis of quantities passing the 100-mesh sieve.

Part 3 - Execution

3.01 Seeding

- A. After installation of the Project, topsoil shall be spread evenly to a minimum 4-inch depth and lightly compacted. No topsoil shall be spread in a frozen or muddy condition.
 - 1. Any stored topsoil remaining after work is in place shall be disposed of by the Contractor as directed by the Engineer.
- B. Soil improvement shall be made if and as recommended by the Agricultural Extension Service prior to seeding.
 - 1. Ground limestone, if required, shall be applied at the recommended rates per square yard and shall be thoroughly mixed into the topsoil.
 - 2. Fertilizers, if required shall be of analysis and rates per square yard as recommended in the topsoil analysis and shall be mixed lightly in the top few inches of topsoil.
- C. Immediately before any seed is to be sown, the ground shall be scarified as necessary and shall be raked until the surface is smooth, friable and of a uniformly fine texture. Areas shall be seeded evenly with a mechanical spreader at a rate of 2 pounds per 1,000 square feet, lightly raked and watered with a fine spray.
- D. After seed has been distributed, the Contractor shall cover areas that are likely to washout with straw to a depth of 1-1/2 inches.
- E. Seeded areas shall be protected and maintained by watering, regular mowing and reseeded as may be necessary to produce a uniform stand of grass. Maintenance shall continue throughout the guarantee period until a dense, uniform turf is established.
- F. All paved streets, roads, sidewalks, curbs, fences, stonewalls, lawns, etc., disturbed during construction shall be restored, repaired, or replaced to as good a condition as existed prior to construction. All materials and workmanship shall conform to standard practices and specifications of the Owner and/or the Kentucky Department of Highways, whichever applies.
- G. The Contractor shall remove from the site all equipment, unused materials and other items at his expense. The construction site shall be left in a neat, orderly condition, clear of all unsightly items, before the Work is finally accepted.

END OF SECTION

Part 1 General

1.01 Related Documents

- A. Drawings and general provisions of Contract, including General and Supplementary Condition apply to work of this section.

1.02 Description of Work

- A. The extent of concrete work shown on drawings.
- B. Concrete paving and walks are specified in Division 2

1.03 Quality Assurance

- A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified.
 - 1. ACI 301 "Specifications for Structural Concrete for Buildings".
 - 2. ACI 318 "Building Code Requirements for Reinforced Concrete".
 - 3. ACI 117 "Standard Specifications for Tolerances for Concrete Construction and Materials".
 - 4. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
- B. Concrete Testing Service: Employ, at Contractor's expense a testing laboratory acceptable to Engineer to perform material evaluation tests, field cylinder tests and to design concrete mixes.
- C. Materials and installed work may require testing and retesting, as directed by Engineer, at anytime during progress of work. Allow free access to material stockpiles and facilities. Tests, not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

1.04 Submittals

- A. Product Data: Submit manufacturers product data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others as requested by Engineer.
- B. Shop Drawings; Reinforcement: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special

reinforcement required and openings through concrete structures.

- C. Samples: Submit samples of materials as specified and as otherwise requested by Engineer, including names, sources and descriptions.
- D. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test as specified.
- E. Material Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Engineer. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

Part 2 Products

2.01 Form Materials

- A. Forms for Exposed Finish Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.
 - 1. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled an edge-sealed, with each piece bearing legible inspection trademark.
- B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. All lumber used must be dressed on at least 2 edges and one side to insure a tight fit.
- C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will impair subsequent treatments of concrete surfaces.

2.02 Reinforcing Materials

- A. Reinforcing Bars (Rebar): ANSI/ASTM A 615, Grade 60, deformed.
- B. Steel Wire: ANSI/ASTM A 82, plain, cold-drawn, steel.
- C. Welded Wire Fabric (WWF): ASTM A 185, welded steel wire fabric (flat sheets).
- D. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise acceptable.

- E. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.03 Concrete Materials

- A. Portland Cement: ANSI/ASTM C 150, Type I, unless otherwise acceptable to Engineer.
- B. Use one brand of cement throughout project, unless otherwise acceptable to Engineer.
- C. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.
- D. Water: Potable.
- E. Air-Entraining Admixture: ASTM C 260.
- F. Calcium chloride not permitted.

2.04 Related Materials

- A. Moisture Barrier: Provide moisture barrier cover over prepared sub-grade for all slab on grade. Use only materials which are resistant to decay when tested in accordance with ASTM E 154, as follows:
 - 1. Polyethylene sheet not less than 10 mils thick.
- B. Chemical Hardener: Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 lbs. of fluosilicates per gal.
- C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
- D. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
 - 1. Waterproof paper.
 - 2. Polyethylene film.
 - 3. Polyethylene-coated burlap.
- E. Liquid Membrane-Forming Curing Compound: Federal Spec TT-C-800, Type I, unless other type acceptable to Engineer.
 - 1. Provide a curing compound compatible with floor sealers and floor finishes in areas to receive sealer and finishes. See Division 9 and room finish schedule for type of floor sealer and finishes.
- F. Expansion Joint Material: Type F by Sonneborn.

2.05 Proportioning and Design of Mixes

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Engineer.
- B. Submit written reports to Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Engineer.
- C. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules.
 - 1. 4500 psi 28-day compressive strength; 600 lbs. cement per cu. yd. minimum; W/C ratio, 0.44 max. Flyash substitution is not permitted.
- D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.
- E. Admixtures:
 - 1. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having air content within following limits:
 - a. Concrete structures and slabs exposed to freezing and thawing or subjected to hydraulic pressure:
3% to 5% for maximum 3/4" aggregate.
 - b. Other Concrete:
2% to 4% air.
- F. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
 - 1. Ramps and sloping surfaces: Not more than 3".
 - 2. Reinforced foundation systems: Not less than 1" and not more than 4".
 - 3. Other concrete: Not less than 1" and not more than 4".

2.06 Concrete Mixes

- A. Job-Site Mixing: Mix materials for concrete in appropriate drum type batch machine mixer. For mixers of one cu. yd., or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cu. yd., increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cu. yd., or fraction thereof.
- B. Provide batch ticket for each batch discharges and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
- C. Ready Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.
 - 1. Delete references for allowing additional water to be added to batch for material with insufficient slump. Addition of water to the batch will not be permitted.
- D. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.
 - 1. When air temperature is between 85 degrees (F) and 90 degrees (F), reduce mixing and delivery time for 1-1/2 hours to 75 minutes, and when air temperature is above 90 degrees (F), reduce mixing and delivery time to 60 minutes.

Part 3 Execution

3.01 Forms

- A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size; shape, alignment, elevation and position.
- B. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.
- C. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

- E. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- F. Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- G. Form Ties: Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.
 - 1. Unless otherwise indicated, provide ties so portion remaining within concrete after removal is at least 1-1/2" inside concrete.
 - 2. Unless otherwise shown, provide form ties which will not leave holes larger than 1" diameter in concrete surface.
- H. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.
- I. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

3.02 Placing Reinforcement

- A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
- C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
- D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.03 Joints

- A. Construction Joints: Locate and install construction joints, which are not shown on drawings, so as not to impair strength and appearance of the structure, as acceptable to Engineer. Where terrazzo floor is indicated, coordinate location with layout of divider strips.
- B. Provide keyways at least 1-1/2" deep in construction joints in walls, slabs and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.
- C. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.
- D. Control Joints: Saw cut joints as shown on the drawings. Joints to be sawn as soon as concrete is set sufficiently, but must be sawn the same day as the concrete is poured. Coordinate location with layout of terrazzo divider strips.

3.04 Installation of Embedded Items

- A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.
- B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

3.05 Preparation of Form Surfaces

- A. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
- B. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturers instructions.
- C. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.06 Concrete Placement

- A. Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete form coatings are not used.

- B. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.
- C. General: Comply with ACI 304, and as herein specified. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
- D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
- E. Consolidate placed concrete by mechanical vibrating equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.
- F. Do not use vibrators to transport concrete inside form. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- G. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
- H. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
- I. Bring slab surfaces to correct level with straightedge and strikeoff. All interior slabs shall pitch to floor drains (if drains are indicated on Engineerural or Mechanical or Structural Drawings). All exterior slabs shall drain away from the building and shall not pond any water. Do not set screeds off metal deck setting on steel beams. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
- J. Maintain reinforcing in proper position during concrete placement operations.
- K. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.
- L. When air temperature has fallen to or is expected to fall below 40 degrees (F), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees (F), and not more than 80 degrees (F) at point of placement.

- M. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
- N. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
- O. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
- P. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees (F). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing.
- Q. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
- R. Wet forms thoroughly before placing concrete.
- S. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or their adverse placing conditions.

3.07 Finish of Formed Surfaces

- A. Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chopped off.
- B. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, painting or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.
- C. Smooth Rubbed Finish: Provide smooth rubbed finish to exposed concrete surfaces, which have received smooth form finish treatment, not later than one day after form removal.
- D. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

- E. Related Uniformed Surfaces: At tops of walls, horizontal offsets surfaces occurring 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.
- F. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, paint or other thin film finish coating system. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand troweling operation, free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding $Ff/FI = 50/25$ for all slabs. Grind smooth surface defects which would telegraph through applied floor covering system.
- G. Chemical-Hardener Finish: Apply chemical-hardener finish to interior concrete floors where indicated by the Engineer on the Room Finish Schedule. Apply liquid chemical-hardener after complete curing and drying of the concrete surface. Dilute liquid hardener with water, and apply in 3 coats; first coat, 1/3-strength; second coat, 1/2-strength; third coat, 2/3-strength. Evenly apply each coat, and allow 24 hours for drying between coats.
 - 1. Apply proprietary chemical hardeners, in accordance with manufacturer's printed instructions.
 - 2. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

3.08 Concrete Curing and Protection

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
- C. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.
- D. Curing Methods: Perform curing of concrete by moist curing, by moisture-retaining cover curing, by curing compound, and by combinations thereof, as herein specified.
- E. Provide moisture curing by following methods.
 - 1. Keep concrete surface continuously wet by covering water.
 - 2. Continuous water-fog spray.

3. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
- F. Provide moisture-cover curing as follows: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- G. Provide curing compound to slabs as follows:
1. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuously operation by powerspray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during period.
 2. Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring, painting, and other coatings and finish materials, unless otherwise acceptable to Engineer. Coordinate with specified finishes and verify before application.
- H. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period of until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
- I. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing compound.
- J. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.
- K. All control and expansion joints shall be cleaned and filled with a self-leveling sealant that complies to ASTM C-920 and applied according to the manufacturers recommendations. The sealant shall be one of the following or an approved equal:
- 1) Sika - Sikaflex - 2c SL
 - 2) Sonneborn - Sonolastic SL 1

3.09 Removal of Forms

- A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of this work, may be removed after cumulatively curing at not less than 50 degrees (F) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

Concrete Work

- B. Formwork supporting weight of concrete, such as beam soffits, joints, slabs and other structural elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in place concrete by testing field-cured specimens representative of concrete location or members.
- C. Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.10 Reuse of Forms

- A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Engineer.

3.11 Inspection

Concrete shall not be placed over pipes, conduits, etc. until such work has been tested, inspected and approved. No concrete shall be deposited until the Engineer has inspected the forms and placing of steel reinforcement and given permission to place concrete.

3.12 Notifying Other Trades

This Contractor shall notify the Mechanical and Electrical Contractors, and all other Contractors, at the proper time to install all conduits, pipes, pipe sleeves, anchors, or other equipment coming under their respective contracts in the form work.

3.13 Miscellaneous Concrete Items

- A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
- B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

3.14 Concrete Surface Repairs

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Engineer.

- B. Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
- C. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- D. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.
- E. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
- F. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having required slope.
- G. Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
- H. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
- I. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Engineer.
- J. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all round. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

- K. Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in area continuously moist for not less than 72 hours.
- L. Use epoxy-based mortar for structural repairs, where directed by Engineer.
- M. Repair methods not specified above may be used, subject to acceptance of Engineer.

3.15 Quality Control Testing During Construction

- A. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - 1. Slump: ASTM C 143; one test for each concrete load at point of discharge; and one test for each set of compressive strength test specimens.
 - 2. Air content: ASTM C 173; volumetric method for light-weight or normal weight concrete; ASTM C 231 pressure for normal weight concrete; one for each set of compressive strength test specimens.
 - 3. Concrete Temperature: Test hourly when air temperature is 40 degrees (F) and below, and when 80 degrees (F) and above; and each time a set of compression test specimens made.
 - 4. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
 - 5. Compressive Strength Tests: ASTM C 39; one set for each 100 cu. yds. or fraction thereof, of each concrete class placed in any one day or for each 5000 sq. ft. of surface area placed; 1 specimen tested at 7 days, 2 specimen tested at 28 days, and one specimen retained in reserve for later testing if required.
 - 6. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
 - 7. When total quantity of a given class of concrete is less than 50 cu. yds., strength test may be waived by Engineer if, in his judgment, adequate evidence of satisfactory strength is provided.
 - 8. When strength of field-cured cylinders is less than 85 % of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

9. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive by more than 500 psi.
- B. Test results will be reported in writing to Engineer, Structural Engineer, and Contractor on same day that tests are made. Reports of compressive strength test shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.
- C. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such test required, when unacceptable concrete is verified.

END OF SECTION

Precast Prestressed Hollow Slab Units

Part 1 - General

1.01 Description of Work

- A. The extent of precast prestressed hollow slab units is shown on the Drawings.
- B. These specifications cover precast and precast prestressed structural concrete construction employing hollowcore planks only, including product design not shown on contract drawings, manufacture, transportation, erection, and other related items such as anchorage, bearing pads, storage and protection of precast concrete.

1.02 Quality Assurance

- A. Standards and Codes: Design units in accordance with requirements of ACI 318, and as herein specified.
- B. Fabricator Qualifications: Fabricated by a firm regularly engaged in the manufacture of precast prestressed hollow slab units.
 - 1. Acceptable manufacturers: A company specializing in providing precast and/or precast prestressed concrete products and services normally associated with the industry for at least 5 years.
 - 2. Erector qualifications: Regularly engaged for at least 3 years in the erection of precast structural concrete similar to the requirements of this project.
 - 3. Qualifications of welders: In accordance with AWS D1.1 Qualified within the past year.
 - 4. Requirements of regulatory agencies: All local codes plus the following specifications, standards and codes are a part of these specifications.
 - a. ACI 318 - Building Code Requirements for Reinforced Concrete.
 - b. AWS D1.1 - Structural Welding Code.
 - c. AWS D12.1 - Reinforcing Steel Welding Code.
 - d. ASTM Specifications - As referred to in Part 2 - Products, of this Specification.
 - e. AASHTO Standard Specifications for Highway Bridges.
 - f. UL Fire Resistance Index.

1.03 Submittals

- A. Shop Drawings; Precast Prestressed Hollow Slab Units: Include manufacturer's standard and special loading chart data for span and load conditions required. Include manufacturer's setting plans and anchorage details.
- B. Show conditions at openings, and header locations and dimensions.
- C. Submit computations by a registered engineer for review with shop drawings.
- D. Product design criteria:
 - 1. Loadings for design.
 - a. Initial handling and erection stresses.
 - b. All dead and live loads as specified on the contract drawings.
 - c. All other loads specified for member where they are applicable.
 - 2. Design calculations of products not completed on the contract drawings shall be performed by a registered engineer experienced in precast prestressed concrete design.
 - 3. Design shall be in accordance with applicable codes, and ACI 318.
 - 4. Products shall satisfy requirements for fire resistance (hour rating and UL design number) as shown on contract drawings.
- E. Permissible design deviations
 - 1. Design deviations will be permitted only after the Architect/Engineer's written approval of the manufacturer's proposed design supported by complete design calculations and drawings.
 - 2. Design deviations shall provide an installation equivalent to the basic intent without incurring additional cost to the owner.
- F. Test reports: Reports of tests on concrete and other materials upon request.

Part 2 - Products

2.01 Materials

- A. Portland cement:
 - 1. ASTM C150 - Type I or III.
 - 2. Use same type, brand and source of supply throughout.