



DIVISION 01

GENERAL REQUIREMENTS



SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Location and description of Work and prior uses of the Site.
 - 2. Construction Contracts for this Project.

1.2 LOCATION AND DESCRIPTION OF WORK

- A. The Work is located in Lyon County, Kentucky at two existing water storage tanks. The Lamasco Tank is a 189,000 gallon standpipe water storage tank located along KY Highway 93 in Lamasco, Kentucky and the Jack Thomason Tanks is a 100,000 gallon elevated water storage tank located in Eddyville, Kentucky.
- B. Work to be performed under this Contract includes, but is not limited to, repair, cleaning, and painting of the Jack Thomason and Lamasco Tanks, Repair and Replacement of various tank components and appurtenances as shown in the Plan Drawings, as well as the installation of a mixing system, anti-corrosion system, bypass line, and altitude valve assembly at the Lamasco Tank, and all other Work required in accordance with the Contract Documents.
- C. The Contractor shall be responsible for the general overall coordination of the work. Each Sub-Contractor shall carefully check the Drawings, Specifications, and the Project Site in order to advise and coordinate their phase of the Work. Each Subcontractor shall leave the required space and clearances for the work of others, field check all dimensions and file a written report to the Engineer where discrepancies occur between the work to be performed and the Drawings, Specifications, or Project Site conditions. If no report is filed prior to approvals of Shop Drawings and Samples, it will be assumed that no conflict occurs. Resolutions of conflicts after Shop Drawings and Sample approvals shall be resolved by the Engineer and the conflict corrected in the field at no increase in the Contract Sum.
- D. All contractors, subcontractors, suppliers, and other employers involved with work at the Project Site shall be responsible for compliance with all federal, state, local, and Project Owner's regulations, standards, and codes in effect during the Contract Time.
- E. All notices, demands, requests, instructions, reports, approvals, proposals, Change Orders, Field Orders, and claims shall be in writing.
- F. The Contractor shall perform all required testing of installed piping, equipment, etc. as required by these Technical Specifications and the owing utility specifications. Adjustments of process equipment will be the responsibility of the Contractor and/or equipment supplier. All systems shall be adjusted and balanced to the approval of the Engineer prior to project closeout.
- G. Contracting Method: The Project will be constructed under a single prime construction Contract

1.3 CONSTRUCTION CONTRACTS FOR THIS PROJECT

- A. Single Prime Construction Contract: The Contract requires all the Work for the Project not expressly allocated to Owner or others in the Contract Documents.

1.4 OTHERS RETAINED BY OWNER FOR THE PROJECT

- A. Engineer:
 - 1. Engineer is identified in the Agreement.
 - 2. Engineer's responsibilities for the Project, relative to Contractor, are indicated throughout the Contract Documents.

3. Whether the Engineer will furnish the services of a Resident Project Representative (RPR) for the Project is indicated in the Supplementary Conditions.

1.5 SEQUENCE AND PROGRESS OF WORK

- A. Sequencing:
 1. Incorporate sequencing of the Work into the Progress Schedule.
 2. Sequencing Requirements:
 - a. Owner must be provided with 72 hours advanced notice before Work commences to allow for the tank to be drained.
 - b. Only one tank may be out of service at a time. At least one tank must be operational at all times.
 - c. Work at either tank site may not commence on a Friday, Saturday, Sunday, or Holiday Monday.

1.6 CONTRACTOR'S USE OF SITE

- A. Use of Site - General:
 1. Relocate stored materials and equipment that interfere with operations of Owner, other contractors, and others performing work for Owner.
- B. The Contractor shall immediately upon entering the Project Site for the purpose of beginning the work, locate all general reference points and take such action as necessary to prevent their destruction; layout his own and be responsible for, all lines, elevations, and measurements of all work to be executed under the Contract.
- C. The Contractor shall exercise proper precautions to verify fixtures shown on the Drawings before laying out the work, and will be held responsible for any error resulting from his failure to exercise such precautions.

1.7 EASEMENTS AND RIGHTS-OF-WAY

- A. Easements and Rights-of-Way - General:
 1. Easements and rights-of-way required for the permanent improvements included in the Work will be provided by Owner in accordance with the General Conditions and Supplementary Conditions.
 2. Confine construction operations within Owner's property, public rights-of-way, easements obtained by Owner, and limits shown, and property for which Contractor has made arrangements directly with property owner(s).
 3. Use care in placing construction tools, machinery and equipment, excavated materials, and materials and equipment to be incorporated into the Work to avoid damaging property and interfering with traffic.
 4. Do not enter private property outside the construction limits without permission from the owner of the property.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 22 00
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General requirements applicable to all bid/pay items.
 - 2. General provisions on unit prices and quantities.
 - 3. General provisions on lump sums.
 - 4. Listing of the various bid/pay items in the Project, together with criteria for measuring Unit Price Work for payment.
- B. Related Requirements:
 - 1. Include but are not necessarily limited to:
 - a. Section 00 41 13 – Bid Form.

1.2 REQUIREMENTS APPLICABLE TO ALL BID/PAY ITEMS

- A. In this Section and elsewhere in the Contract Documents, the terms “bid item”, “pay item”, “bid/pay item”, “Item” followed by a number designation, “this item”, and the like all have the same meaning, and refer to one or more specific elements of the Contract, established for pricing and payment, as indicated in the Bid Form and in the Agreement (or exhibit to the Agreement) at the time the Contract was signed by the parties.
- B. This Article applies to all bid/pay items in the Contract.
- C. Prices – General:
 - 1. The bid/pay items listed starting with Article 1.5 of this Section refer to and are the same bid items listed in the Bid Form and included in the Contract, and constitute all bid/pay items for the Work at the time the Contract was signed by the parties.

2. No direct or separate payment will be made, outside of the bid/pay items in the Contract, for the following: providing miscellaneous temporary or accessory materials or equipment, temporary works, temporary construction facilities, Contractor's project management, superintendence, and similar costs for Subcontractors or Suppliers; [bonds and] insurance; schedules and schedule updates; coordination (with: Owner's [and facility manager's (if other than Owner)] operations (including, but not limited to, lockout/tag-out procedures), other contractors, utility owners, owners of transportation facilities, adjacent property owners and occupants, authorities having jurisdiction, Subcontractors and Suppliers, and others with whom Contractor is to coordinate the Work); information technology systems required by the Contract Documents; Submittals; photographic documentation; Project meetings; Contractor's hazard communication program; Contractor's compliance with environmental procedures for Constituents of Concern (including spill control and countermeasures plans and implementation); professional services (required for Contractor's means and methods of construction, and for delegated designs required by the Contract Documents); obtaining and complying with permits and licenses; temporary utilities (including electric power, water supply and disposal, fuel, and communications); temporary lighting; temporary fire protection; temporary enclosures and HVAC; temporary sanitary facilities; temporary first-aid facilities and services; ; Contractor's field offices and sheds, Engineer's field offices (when required elsewhere in the Contract Documents); temporary vehicular access and parking (including access to the Site, temporary access roads and parking, onsite traffic controls for construction traffic, and offsite haul routes); traffic control of non-construction vehicular and pedestrian traffic; temporary controls (including temporary erosion and sediment controls, noise control, control of storm water, surface water, and groundwater, pollution controls (including solid waste control, water pollution control, and control of atmospheric pollution), dust control, pest and rodent controls, odor controls, and other temporary controls required by the Contract Documents); temporary security for the Work; temporary barriers; Project signage (when required elsewhere in the Contract Documents); delivering, handling, and storing materials and equipment to be incorporated into the Work; layouts and surveys for the Work; construction equipment, machinery, tools, and vehicles; safety and protection; Site maintenance during construction; cleaning and removal and disposal of waste and debris; checkout and startup; testing and other quality control activities required by the Contract Documents; record documents, operation and maintenance data; warranties; spare parts and extra materials required by the Contract Documents; instruction of facility personnel as required by the Contract Documents; commissioning (when required elsewhere in the Contract Documents); Contractor's correction period, Contractor's general warranty and guarantee; Contractor's indemnification obligations; other labor, cost, or effort required by the General Conditions and Supplementary Conditions, Division 01 Specifications, and other requirements of the Contract Documents.
3. Price Escalation:
 - a. Unless expressly indicated otherwise in the Contract Documents, Owner is not obligated to change the stipulated prices (including lump sums, unit prices, and allowances) that are all or part of the Contract Price because of escalation of costs when there is no corresponding change in the Contract Times.
 - b. Changes in the Contract Times do not necessarily entitle Contractor to a change in Contract Price due to escalation.
 - c. Should Contractor claim a change in Contract Price for one or more stipulated price pay items without a corresponding change in scope, extent, or quality in the associated Work, prior to receiving any such change in Contract Price, Contractor shall submit with Contractor's associated Change Proposal, documentation satisfactory to Engineer supporting and documenting that Contractor's costs have increased because of delays beyond Contractor's control within the associated change in Contract Times included in such Change Proposal.
4. Compensation for all services, labor, materials, and equipment shall be included in prices stipulated for the unit price bid/pay items in the Contract.

5. Each unit price in the Contract shall include an amount considered by Contractor as sufficient for all overhead and profit for each separately identified bid/pay item.
- D. Contract Price, Payment Procedures, and Related Matters:
1. Contract Price: The Contract Price, as apportioned among bid/pay items in the Contract, is indicated in the Agreement and any associated exhibits thereto and may be modified by Change Order.
 2. Payments to Contractor: Refer to the General Conditions (as may be modified by the Supplementary Conditions), the Agreement (including provisions on retainage, if any), among other applicable Contract Documents.
 3. Schedule of Values: Refer to the General Conditions (as may be modified by the Supplementary Conditions).
 4. Procedures for Changes in Contract Price: Refer to the General Conditions (as may be modified by the Supplementary Conditions)..
 5. Alternates: The scope and limits of alternates, when contemplated for or included in the Contract, may be addressed, in whole or in part, in Section 01 23 00 - Alternates.
 6. Defective Work is not eligible for payment.

1.3 GENERAL PROVISIONS ON UNIT PRICES AND QUANTITIES

- A. Quantities:
1. Quantities of Unit Price Work indicated in the Bid Form and in the Contract (at the time the Agreement was signed by the parties) are estimates for purposes of pricing and comparison of Bids.
 2. Owner does not represent, either expressly or by implication, or agree that the nature of materials encountered below ground surface or in concealed areas, or actual quantities of Unit Price Work required, will correspond with the quantities in the Contract at the time the Agreement was signed by the parties. Owner reserves the right to increase or decrease quantities, and to eliminate quantities, as Owner may deem necessary or as may be necessary due to Site conditions encountered.
 3. Adjustment of Unit Prices Due to Variation in Quantities:
 - a. Provisions, if any, regarding adjustment of unit prices due to variations in actual quantities (eligible for payment) from the estimated quantities in the Contract (including quantities at the time the Agreement was signed by the parties and as subsequently modified by Change Order) are in the General Conditions, as may be modified by the Supplementary Conditions.
 - 1) Engineer's review for possible unit price adjustment, when provision for such adjustment is expressly indicated in the Contract, will be at a time Engineer deems reasonable and proper.
 - 2) When the Supplementary Conditions establish that, to be eligible for an adjustment in the unit price, a pay item of Unit Price Work must have a total computed, extended price (at the time the Agreement was signed by the parties) equal to or greater than a specified percentage (stipulated in the Supplementary Conditions) of the total Contract Price (at the time the Agreement was signed by the parties), and the total extended price of such pay item does not exceed the stipulated percentage of the Contract Price, then the associated pay item will be paid at the unit price in the Contract without adjustment for variations in actual quantity.
 4. Quantities eligible for payment will be actual quantities furnished and installed (as applicable) in accordance with the Contract Documents, within the pay limits shown or indicated, as measured by Engineer (or other entity so empowered in the Contract Documents), and recommended for payment by Engineer.
 5. At Contractor's expense, Contractor may independently verify quantities measured by Engineer for payment. Should Contractor disagree with quantities measured and recommended for payment by Engineer, submit appropriate Change Proposal (appealing Engineer's measurements) indicating the specific reasons for Contractor's appeal, with detailed reasons therefor and associated calculations and estimates, in accordance with the Contract Documents.

6. Quantity Overruns:
 - a. When the quantity of a pay item of Unit Price Work eligible for payment exceeds the pay item's quantity included in the Contract, Owner will pay for quantities that exceed those in the Contract only while the estimated total payments to Contractor under the Contract will not exceed the Contract Price. Otherwise, a Change Order is required to modify the associated quantity in the Contract, thus changing the Contract Price.
 7. Except as may be established elsewhere in the Contract Documents, make no claim for anticipated profit, loss of profit, damages, or additional compensation arising from difference between quantities of Unit Price Work eligible for payment and the estimated quantities in the Contract.
- B. Measuring for Payment:
1. At Engineer's option, Engineer may delegate to Resident Project Representative (RPR) (if any), some or all of Engineer's responsibilities for measuring Unit Price Work eligible for payment.
 2. Unless expressly indicated otherwise in the Contract Documents, measurements will be in United States standard measurements.
 3. Unless indicated otherwise elsewhere in the Contract Documents, quantities of Unit Price Work eligible for payment will be rounded to the nearest whole number.
 4. In the event of conflict between this Section and the measurement criteria in the Specifications of Divisions 02-49, the measurement criteria in this Section will govern. Typical intent when measurement criteria are in both this Section and the associated Division 02-49 Specifications section, is for the criteria to be interpreted together.
 5. Assistance with Measurements:
 - a. Assist Engineer and Resident Project Representative (RPR) (if any), by providing measuring equipment, labor, and survey personnel necessary to measure quantities eligible for payment.
 6. Quantities eligible for payment can be adjusted by Engineer to correct quantities included in Contractor's prior payment requests, and for incomplete or defective Unit Price Work. Such corrections are at Engineer's sole discretion.

1.4 GENERAL PROVISIONS ON LUMP SUM ITEMS

- A. Progress payments for Work paid on a lump sum basis will be based on Engineer's estimate of the Work (in accordance with the Contract Documents) performed through the end of the associated pay period, based on the Schedule of Values accepted by Engineer in accordance with the Contract Documents.
- B. At its sole discretion, Engineer may correct amounts of lump sum Work included in prior payment requests based on improved data or information available to Engineer, or Engineer's knowledge or reasonable belief that Work is incomplete or defective.

1.5 BID/PAY ITEMS – GENERAL CONTRACT

- A. Item 1 – Repair, Cleaning, and Painting of 100,000 gallon Jack Thomason Tank:
 1. Measurement: Lump Sum.
 2. Item Includes:
 - a. Coordination with Owner to isolate and drain tank.
 - b. Thorough inspection of tank and reporting of conditions.
 - c. Preparation of all surfaces to be cleaned and receive finishes.
 - d. Collection, handling, and disposal of debris.
 - e. Completion of all tank repairs.
 - f. Finishing of all surfaces.
 - g. Testing, cleaning, and disinfection of tanks.
 3. Payment: Per completion of all work associated with the cleaning, repair, and finishing of the Jack Thomason Tank.
- B. Item 2 – Replacement of Manway for Jack Thomason Tank:
 1. Measurement: Lump Sum.

2. Item Includes:
 - a. Thorough inspection of manway and hardware.
 - b. Removal/Demo of existing manway and hardware.
 - c. Installation of new, round, multi-bolt type manway.
 3. Payment: Per completion of all work associated with the removal and replacement of the manway.
- C. Item 3 – Replacement of Level Indicator for Jack Thomason Tank:
1. Measurement: Lump Sum.
 2. Item Includes:
 - a. Removal/Demo of level indicator.
 - b. Installation of new level indicator.
 3. Payment: Per completion of all work associated with the replacement of the level indicator.
- D. Item 4 – Installation of Stiffener Ring for Jack Thomason Tank:
1. Measurement: Lump Sum.
 2. Item Includes:
 - a. Installation of stiffener ring at joint between riser and tank bowl.
 3. Payment: Per completion of all work associated with the installation of the stiffener ring.
- E. Item 5 – Roof Screen Replacement for Jack Thomason Tank:
1. Measurement: Lump Sum.
 2. Item Includes:
 - a. Removal/Demo of existing roof screens.
 - b. Installation of new frost-free type roof screens.
 3. Payment: Per completion of all work associated with the removal and replacement of roof screens.
- F. Item 6 – Grouting of Tank Base for Jack Thomason Tank:
1. Measurement: Lump Sum.
 2. Item Includes:
 - a. Preparation of surface and joint for grouting.
 - b. Installation of grout around entire base of tank
 3. Payment: Per completion of all work associated with the grouting of the tank base.
- G. Item 7 – Replacement of Safety Climb and Hardware for Jack Thomason Tank:
1. Measurement: Lump Sum.
 2. Item Includes:
 - a. Removal/Demo of existing safety climb and hardware.
 - b. Installation of new safety climb.
 3. Payment: Per completion of all work associated with the installation of new safety climb.
- H. Item 8 – Repair, Cleaning, and Painting of 189,000 gallon Lamasco Tank:
1. Measurement: Lump Sum.
 2. Item Includes:
 - a. Coordination with Owner to isolate and drain tank.
 - b. Thorough inspection of tank and reporting of conditions.
 - c. Preparation of all surfaces to be cleaned and receive finishes.
 - d. Collection, handling, and disposal of debris.
 - e. Completion of all tank repairs.
 - f. Finishing of all surfaces.
 - g. Testing, cleaning, and disinfection of tanks.
 3. Payment: Per completion of all work associated with the cleaning, repair, and finishing of the Lamasco Tank.
- I. Item 9 – Installation of Hydrodynamic Mixing System for Lamasco Tank:
1. Measurement: Lump Sum.
 2. Item Includes:
 - a. Provide all submittals for mixing system in accordance with contract documents.

- b. Provide all equipment and appurtenances needed to install the mixing system.
 - c. Install mixing system.
 - d. Start-up and test per contract documents
 - 3. Payment: Per completion of all work associated with the installation of the mixing system for the Lamasco Tank.
- J. Item 10 – Installation of Anti-Corrosion System for Lamasco Tank:
 - 1. Measurement: Lump Sum.
 - 2. Item Includes:
 - a. Provide all equipment suitable for potable water system
 - b. Consult glass lined tank manufacturer for required procedures for installation of all equipment and penetrations made through the tank sidewalls.
 - c. Install Anti-corrosion system
 - 3. Payment: Per completion of all work associated with the installation of the anti-corrosion system for the Lamasco Tank.
- K. Item 11 – Installation of 8-inch Bypass Line for Lamasco Tank:
 - 1. Measurement: Lump Sum.
 - 2. Item Includes:
 - a. Construction of new 8 inch DIP bypass line and appurtenances around existing valve vault as shown on drawings.
 - b. Installation of new flush hydrant.
 - 3. Payment: Per completion of all work associated with the installation of new bypass line, valves, and flush hydrant.
- L. Item 12 – Assembly and Installation of Altitude Valve for Lamasco Tank:
 - 1. Measurement: Lump Sum.
 - 2. Item Includes:
 - a. Installation of new altitude valve and appurtenances as shown on Plan Drawings
 - 3. Payment: Per completion of all work associated with the installation of altitude valve assembly for the Lamasco Tank.
- M. Item 13 – Replacement of Manway Gaskets and Bolts for Lamasco Tank:
 - 1. Measurement: Lump Sum.
 - 2. Item Includes:
 - a. Removal/demo of existing gaskets and bolts.
 - b. Installation of new gaskets and bolts for manway.
 - 3. Payment: Per completion of all work associated with the replacement of manway gaskets and bolts.
- N. Item 14 – Roof Screen Replacement for Lamasco Tank:
 - 1. Measurement: Lump Sum.
 - 2. Item Includes:
 - a. Removal/Demo of existing roof screens.
 - b. Installation of new frost-free type roof screens.
 - 3. Payment: Per completion of all work associated with the removal and replacement of roof screens.
- O. Item 15 – Grouting of Tank Base for Lamasco Tank:
 - 1. Measurement: Lump Sum.
 - 2. Item Includes:
 - a. Preparation of surface and joint for grouting.
 - b. Installation of grout around entire base of tank
 - 3. Payment: Per completion of all work associated with the grouting of the tank base.
- P. Item 16 – Replacement of Safety Climb and Hardware for Lamasco Tank:
 - 1. Measurement: Lump Sum.
 - 2. Item Includes:
 - a. Removal/Demo of existing safety climb and hardware.

- b. Installation of new safety climb.
- 3. Payment: Per completion of all work associated with the installation of new safety climb.

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R. Item 17 – Mobilization and Demobilization:

- 1. Measurement: Lump Sum.
- 2. Item Includes:
 - a. Work and activities indicated in this provision are intended as illustrative for purposes of scope and payment and do not represent a complete list of all preconstruction activities and Submittals, or all Work or activities required by the contract for mobilization and demobilization.
 - b. Mobilization Work paid under this item will include:
 - 1) Furnishing required performance bond and payment bond.
 - 2) Furnishing required insurance and associated documentation.
 - 3) Obtaining Owner’s acceptance of proposed Subcontractors and Suppliers and entering into subcontracts and purchase orders needed to start the Work.
 - 4) Preparing and obtaining Engineer’s approval of Shop Drawings as required.
 - 5) Preparing and obtaining Engineer’s acceptance of schedules, including Progress Schedule, Schedule of Submittals, and Schedule of Values.
 - 6) Preconstruction conference(s) required by the Contract Documents.
 - 7) Preconstruction photographic documentation.
 - 8) Establishing Contractor’s Site-specific health and safety plan, preconstruction activities needed to start implementing Contractor’s safety programs, and verifying status of training of construction workers and personnel and condition of construction equipment, machinery, and tools.
 - 9) Submitting acceptable emergency contact information
 - 10) Obtaining required permits needed to start the Work.
 - 11) Initial establishment of temporary utilities and temporary facilities.
 - 12) Establishing Contractor’s field office and sheds, [Engineer’s field office,] Contractor’s storage areas, staging and laydown areas, and other areas necessary to perform the Work.
 - 13) Initial establishment of construction vehicular access to the Site, parking needed for construction, and offsite haul routes.
 - 14) Establishing construction equipment, machinery, and tools at the Site.
 - 15) Providing initial temporary controls.
 - 16) Temporary security needed to start Work at the Site.
 - 17) Other mobilization acceptable to Engineer.
 - c. Demobilization Work paid under this item will include:
 - 1) Removal from the Site and adjacent areas of excess materials and equipment.
 - 2) Removal of temporary controls, temporary facilities, temporary barriers, and similar materials and equipment.
 - 3) Removal of temporary access roads and parking areas not part of permanent pavement or otherwise allowed to remain by Owner, including temporary traffic controls established for construction vehicles and equipment.
 - 4) Removal of all field office and sheds, storage areas, staging and laydown areas, and other areas needed to perform the Work and restoration of such areas.
 - 5) Removal from the Site of all construction equipment, machinery, tools, Contractor’s containers, temporary fuel storage tanks, and similar items.
 - 6) Closeout of permits on which Contractor is a permittee or co-permittee.
 - 7) Final cleaning.
 - 8) Furnishing required closeout documents.
 - 9) Other costs and effort by Contractor for demobilization.
 - d. Other cost and Work are under other bid/pay items in the Contract.
- 3. Payment: Lump sum price for this item will be full compensation for all mobilization and demobilization required and needed for the Contract, not included under other bid/pay items or contracts.

- S. Item 18 – Site Restoration:
1. Measurement: Lump Sum.
 2. Item Includes (all in accordance with the Contract Documents):
 - a. Rough grading, providing appropriate topsoil (whether originally removed and stockpiled by contractor or from offsite sources), and final grading (appropriately transitioning to proposed grades at completion of Work), without ponding of water.
 - b. Soil stabilization.
 - c. Reinstalling existing materials and systems removed and properly preserved by Contractor, such as hardscape features (such as, stone patios, walkways, retaining walls and terrace gardens, pools, water features, shoreline and beach protection, and others), benches and outdoor furniture, mailboxes, fencing, signs, ornaments, appurtenances, and the like.
 - d. Repairing or replacing materials and systems damaged or destroyed by Contractor, such as hardscape features, benches and outdoor furniture, mailboxes, fencing, signs, ornaments, appurtenances, and the like.
 - e. Landscaping restoration for areas (unpaved and not subject to vehicular traffic) disturbed by Contractor outside of the pay limits shown or indicated.
 - f. Other Work required and necessary for landscaping restoration not expressly included in other bid/pay items.
 3. Payment: Lump sum payment per full restoration of sites to pre-construction conditions.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 78 36
WARRANTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. General requirements for warranties required in the various Specifications.
 2. Provisions addressing:
 - a. Suppliers' standard warranties.
 - b. Suppliers' special or extended warranties.
 - c. Commencement and duration of warranties.

1.2 SUBMITTALS

- A. General:
1. For each item of equipment furnished under the Contract, submit Supplier's standard warranty, regardless of whether such warranty or Submittal thereof is required by the associated Specifications for that item. Submit such warranties for materials where such Submittal is required in the Specifications for the material.
 2. For each item of material or equipment where Supplier's special (or extended) warranty is required by the Contract Documents, submit appropriate special warranty that complies with the Contract Documents.
 3. Supplier's warranties shall be specifically endorsed to Owner, Contractor, and the entity purchasing the item (if other than Contractor) by the entity issuing such warranty.
 4. Submit Suppliers' standard warranties and special warranties as Submittals in accordance with the Schedule of Submittals accepted by Engineer.

1.3 CONTRACTOR'S GENERAL WARRANTY AND CORRECTION PERIOD OBLIGATIONS

- A. Contractor's General Warranty and Guarantee: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.
- B. Contractor's Warranty of Title: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.
- C. Correction Period: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.

1.4 SUPPLIERS' WARRANTIES FOR MATERIALS AND EQUIPMENT

- A. Warranty Types:
1. Required by the General Conditions:
 - a. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, Contractor's general warranty and guarantee and requirements for the Contract's correction period.
 - b. Disclaimers and limitations in specific materials and equipment warranties do not limit Contractor's general warranty and guarantee, nor does such affect or limit Contractor's performance obligations under the correction period.
 2. Material or equipment manufacturer's standard warranty is pre-printed, written warranty published by item's manufacturer and specifically endorsed by manufacturer to the entities indicated in this Specifications Section's Article 1.2.
 3. Special warranty is written warranty that either extends the duration of material or equipment manufacturer's standard warranty or provides other, increased rights to Owner and other beneficiaries (if any) of such warranty. Where the Contract Documents indicate specific requirements for warranties that differ from the manufacturer's standard warranty for that item, special warranty is implied.

- B. Requirements for Special Warranties:
1. Submit written special warranty document that contains appropriate provisions and identification, ready for signature by material or equipment manufacturer, Owner, and other beneficiaries indicated in Article 1.2 of this Specifications Section. Submit draft warranty with Submittals required prior to fabrication and shipment of the item from the Supplier's facility.
 2. Manufacturer's Standard Form: Modified to include Project-specific information and properly signed by product manufacturer and other entities as appropriate.
 3. Specified Form: When specified forms for special warranties are included in the Contract Documents, prepare written document, properly signed by item manufacturer, Owner, and other beneficiaries indicated in Article 1.2 of this Specifications Section, using the required form.
 4. Refer to the Specifications for content and requirements for submitting special warranties.

1.5 COMMENCEMENT AND DURATION OF WARRANTIES

- A. Commencement of Warranties:
1. Contract correction period and Contractor's general warranty commence as indicated in the General Conditions, as may be modified by the Supplementary Conditions.
 2. Suppliers' standard warranties and special warranties commence running on the date that the associated item is certified by Engineer as substantially complete in accordance with the Contract Documents. In no event shall special warranties commence running prior to Engineer's review and acceptance of special warranty Submittal for the item.
 3. Implied warranties commence in accordance with Laws and Regulations.
- B. Duration of Warranties:
1. Duration of correction period is set forth in the General Conditions, as may be modified by the Supplementary Conditions.
 2. Duration of Contractor's general warranty and guarantee is in accordance with Laws and Regulations.
 3. Duration of Suppliers' standard warranties is in accordance with the applicable standard warranty document accepted for the Project by Engineer.
 4. Duration of required Suppliers' special warranties shall be in accordance with the requirements of the Contract Documents for the subject item.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION



DIVISION 31

EARTHWORK



SECTION 31 23 00
EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Excavate, backfill, compact, and grade the site to the elevations shown on the Drawings, as specified herein, and as needed to meet the requirements of the construction shown in the Contract Documents. All excavation shall comply also with Kentucky OSHA 29 CFR Part 1926, Subpart P. Failure to comply with Subpart P will justify the issuance of a stop work order by the Owner.
- B. Related Specification Sections include but are not necessarily limited to:
1. Section 31 23 33 – Trenching, Backfill, and Compacting for Utilities.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. ASTM International (ASTM):
 - a. C33/C33M, Standard Specification for Concrete Aggregates.
 - b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LBF/FT³).
 - c. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 FT-LBF/FT³(2,700 kN-M/M³)).
 - d. D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - e. D3786, Standard Test Method for Bursting Strength of Textile Fabrics--Diaphragm Bursting Strength Tester Method.
 - f. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - g. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - h. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 2. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR Part 1926.650, Safety and Health Regulations for Construction - Excavations, referred to herein as OSHA Standards.
- B. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- C. Use equipment adequate in size, capacity, and numbers to accomplish the work of this Section in a timely manner.
- D. In addition to complying with requirements of governmental agencies having jurisdiction, comply with the directions of the soil engineer.

1.3 DEFINITIONS

- A. Excavation:
1. Consists of removal of material encountered to subgrade elevations required or indicated.
 2. Includes excavation of soils; pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; boulders; and rock.
- B. Foundations: Footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil or rock.

- C. Geotechnical Engineer: Independent geotechnical specialist providing field quality control for the project.
- D. Non-Structural Fill/Backfill: Soil materials placed and compacted to achieve finish grade elevations that do NOT support foundations, slabs, paving, or other flatwork.
- E. Structure: Buildings, foundations, slabs, tanks, curbs, or other man-made stationary features occurring above or below ground surface.
- F. Subgrade: The earth or soil layer immediately below foundation bearing elevation, subbase material, fill material, backfill material, or topsoil materials.
- G. Unauthorized Excavation:
 - 1. Consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer.
 - a. Unauthorized excavation, as well as associated remedial work as directed by Engineer or Geotechnical Engineer, shall be at Contractor's expense.
 - 2. Unsuitable Soil Materials: Soil materials encountered at or below subgrade elevation of insufficient strength and stiffness to support construction as determined by the Geotechnical Engineer.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 2. Certifications.

1.5 PROJECT CONDITIONS

- A. Salvageable Items: Carefully remove items to be salvaged, and store on Owner's premises unless otherwise directed.
- B. Dispose of waste materials, legally, off site.
 - 1. Burning, as a means of waste disposal, is not permitted.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Fill and Backfill:
 - 1. Provide soil materials free from organic matter and deleterious substances, containing no rocks or lumps over 6" in greatest dimension, and with not more than 15% of the rocks or lumps larger than 2-3/8" in their greatest dimension.
 - 2. Fill material is subject to the approval of the soil engineer, and is that material removed from excavations or imported from off-site borrow areas, predominantly granular, non-expansive soils free from roots and other deleterious matter.
 - 3. Provide fill material free of rocks having a dimension greater than 1" in the upper 12" of fill or embankment.

2.2 TOPSOIL

- A. Where and if shown on the Drawings or otherwise required, provide topsoil consisting of friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, capable of sustaining healthy plant life, and reasonably free from subsoil, roots, heavy or stiff clay, stones, noxious weeds, sticks, brush, litter, and other deleterious matter.
- B. Obtain topsoil from sources within the project limits, or provide imported topsoil obtained from approved sources outside the project limits, or from both sources.

2.3 SELECT BACKFILL

- A. Use select backfill only as directed by the Engineer or as shown on the drawings.
- B. Materials utilized for select fill shall be subject to the Engineer's approval. Provide select fill meeting the following requirements:
 - 1. Compacted Limestone. Provide and place limestone dense graded aggregate conforming to Section 805 of the Kentucky Department of Highways Standard Specifications.
- C. Payment will be made to the Contractor for the amount of select fill installed at the field engineer's request. Payment will not be made to the Contractor for select fill utilized in the replacement of defective work.

2.4 80 PSI FLOWABLE FILL CONCRETE

- A. General. Provide flowable fill meeting the requirements specified in the following sections of the Kentucky Highway Department's current Standard Specifications for Road and Bridge Construction:

- Portland Cement, Type I, Section 801
- Sand, Section 804
- Fly Ash, Class F, Section 844
- Water, Section 803

Unless otherwise approved by the Engineer, proportion flowable fill as follows, per cubic meter (cubic yard):

- Cement, 14 kg (30 lbs.)
- Fly Ash, Class F, 136 kg (300 lbs.)
- Sand (S.S.D.), 1360 kg (3000 lbs.)
- Water (Maximum), 250 kg (550 lbs)

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PROCEDURES

- A. Utilities:
 - 1. Unless shown to be removed, protect active utility lines shown on the Drawings or otherwise made known to the Contractor prior to excavating. If damaged, repair or replace at no additional cost to the Owner.
 - 2. If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.
 - 3. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner.
 - 4. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure his instructions.
 - 5. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.
- B. Placing Flowable Fill Concrete

1. Unless otherwise approved by the Engineer, deliver flowable fill in revolving drum truck mixers in accordance with Section 601 of the Kentucky Highway Department's current Standard Specifications for Road and Bridge Construction to ensure that the mixture is in suspension when placed. Agitation will be required during transportation and waiting time. Subsidence may occur if the mixer is not agitated. Place flowable fill by discharging directly from truck chutes into the trench or by means of conveyors, buckets or pumps.
 2. Place flowable fill a minimum of eight (8) hours prior to the addition and compaction of any material above it unless otherwise directed by the Engineer.
 3. Unless otherwise indicated on the Drawings or in these Specifications, or unless otherwise directed by the Owner or Engineer, do not place flowable fill concrete directly on or around buried pipes. Any newly installed or existing pipelines located in a trench or other excavation to be backfilled with flowable fill concrete is to be bedded in granular material in keeping with the Drawing details from four (4) inches below to twelve (12) inches above the pipe for the entire trench width before placement of the flowable fill concrete.
- C. Protection of persons and property:
1. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.
 2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
 3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this Section.
- D. Dewatering:
1. Remove all water, including rain water, encountered during construction to an approved location by pumps, drains, and other approved methods.
 2. Keep excavations and site construction area free from water.
- E. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.
- F. Maintain access to adjacent areas at all times.

3.3 PROTECTION

- A. Erosion Control:
1. Clean paved roadways daily of any spillage of dirt, rocks or debris from vehicles and equipment entering or leaving site.
 2. Conduct work to minimize erosion of site. Remove eroded material washed off site.
 - a. If necessary or requested by Engineer, construct stilling areas to settle and detain eroded material.
- B. Protect existing surface and subsurface features on-site and adjacent to site as follows:
1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
 2. Protect and maintain benchmarks, monuments or other established reference points and property corners.
 - a. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
 3. Verify location of utilities.
 - a. Omission or inclusion of utility items does not constitute nonexistence or definite location.
 - b. Secure and examine local utility records for location data.
 - c. Take necessary precautions to protect existing utilities from damage due to any construction activity.
 - 1) If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.

- 2) Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Owner and then only after acceptable temporary utility services have been provided.
- 3) Obtain Owner's approval prior to disconnecting any utility service.
- d. Repair damages to utility items at own expense.
- e. In case of damage, notify Engineer at once so required protective measures may be taken.
4. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be removed.
 - a. Protect new and existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - b. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition.
 - c. All repairs to be made and paid for by Contractor.
5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.
6. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
7. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.

3.4 SITE EXCAVATION AND GRADING

- A. The site excavation and grading work includes the offsite disposition of all material:
 1. That exceed quantities required for earthwork on the project.
 2. That the Geotechnical engineer classifies as unclassified excavation.
 3. That the Geotechnical engineer classifies as unacceptable.
 4. That the Geotechnical engineer classifies as potentially contaminated.
- B. Excavation and Grading:
 1. Perform as required by the Contract Drawings.
 2. Excavate trenches in open cut, by a trencher or backhoe of sufficient depth and width to meet the requirements of the installation section of these specifications. Provide no abrupt changes in grade of the main.
 3. Contract Drawings may indicate both existing grade and finished grade required for construction of Project.
 - a. Stake all units, structures, piping, roads, parking areas and walks and establish their elevations.
 - b. Perform other layout work required.
 - c. Replace property corner markers to original location if disturbed or destroyed.
 4. Preparation of ground surface for embankments or fills:
 - a. Before fill is started, scarify to a minimum depth of 6 IN in all proposed embankment and fill areas.
 - b. Where ground surface is steeper than one vertical to four horizontal, plow surface in a manner to bench and break up surface so that fill material will bind with existing surface.
 5. Uniformly grade the areas within limits of grading under this Section, including adjacent transition areas.
 6. Smooth the finished surfaces within specified tolerance.
 7. Compact with uniform levels or slopes between points where elevations are shown on the Drawings, or between such points and existing grades.
 8. Where a change of slope is indicated on the Drawings, construct a rolled transition section having a minimum radius of approximately 8'0", unless adjacent construction will not permit such a transition, or if such a transition defeats positive control of drainage
 9. Grade areas adjacent to buildings to achieve drainage away from the structures, and to prevent ponding.
 10. Finish the surfaces to be free from irregular surface changes, and:

- a. Shape the surface of areas scheduled to be under walks to line, grade, and cross-section, with finished surface not more than 0.10 ft above or below the required subgrade elevation.
 - b. Shape the surface of areas scheduled to be under pavement to line, grade, and cross-section, with finished surface not more than 0.05 ft above or below the required subgrade elevation.
11. Protection of finish grade:
- a. During construction, shape and drain embankment and excavations.
 - b. Maintain ditches and drains to provide drainage at all times.
 - c. Protect graded areas against action of elements prior to acceptance of work.
 - d. Reestablish grade where settlement or erosion occurs.
- C. Borrow:
- 1. Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification.
 - 2. Include cost of all borrow material in original proposal.
 - 3. Fill material to be approved by Geotechnical Engineer prior to placement.
- D. Construct embankments and fills as required by the Contract Drawings:
- 1. Construct embankments and fills at locations and to lines of grade indicated.
 - a. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.
 - 2. Provide approved fill material which is free from roots, organic matter, trash, frozen material, and stones having maximum dimension greater than 6 IN.
 - a. Ensure that stones larger than 4 IN are not placed in upper 6 IN of fill or embankment.
 - b. Do not place material in layers greater than 8 IN loose thickness.
 - c. Place layers horizontally and compact each layer prior to placing additional fill.
 - 3. Compact soils as required to obtain specified density. Selection of appropriate equipment is the Contractor's responsibility.
 - a. In general, compact cohesive soils by sheepsfoot, and granular soils by pneumatic rollers, vibrators, or by other equipment as required to obtain specified density.
 - b. Control moisture for each layer necessary to meet requirements of compaction.

3.5 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

- A. General:
- 1. In general, work includes, but is not necessarily limited to, excavation for structures and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction.
 - 2. Obtain fill and backfill material necessary to produce grades required.
 - a. Materials and source to be approved by Geotechnical Engineer.
 - b. Excavated material approved by Geotechnical Engineer may also be used for fill and backfill.
 - 3. In the paragraphs of this Specification Section, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.
- B. Trenching Operations
- 1. Conduct the excavation in such a manner as to cause the least interruption or hazard to traffic. Exercise caution to avoid damage to surfaced roadways and repair any such damage to an equal of its original condition. Restore drainage structures damaged during the work, or obstructed by operations, to satisfactory condition as soon as possible. Where traffic must cross open trenches, provide suitable bridges and flagmen.
- C. Line Excavation

1. Make the excavation so that the entire length of the main shall lie upon the bottom of the trench. Excavation around all connections shall be of sufficient size to admit a free access for making the required connection. Where noted on the Plans, remove excavated material from the trench by loading directly into a truck, and hauling to a predetermined dump site not located within the realm of the project.
- D. Length
1. Do not advance the excavation of the trench more than 50 FT ahead of the pipe work, except where it is necessary to drain wet ground. The Contractor must assume the risk of meeting water, quicksand, hardpan, boulder clay, and existing utility lines.
- E. Excavated Material
1. Store excavated materials to be used as backfill in a neat pile adjacent to the excavation. Do not endanger the work, traffic, or obstruct drainage unnecessarily. Remove excavated materials not suitable for backfilling, or surplus backfill and suitably dispose of within a twenty-four (24) hour period. Where noted on the Plans, remove excavated material from the trench, load directly into a truck, and haul to a predetermined dump site not located within the realm of the project
- F. Open Trench
1. Do not open more than 100 linear feet of trench at any one time, including sections partially backfilled and being tested.
- G. Ditch Protection
1. To prevent caving or to protect existing roadways, utilities, or structures, sheet or brace the trench as necessary. Sheeting, where required, shall remain in place until the pipe has been laid and tested. Where sheeting is place, the earth above the pipe shall be well tamped for a depth of at least 6 IN above the pipe barrel.
- H. Dewatering
1. Keep trenches and other excavations adequately dewatered. Place discharge from pumps, drains, or bailing in such a way as to not introduce turbidity, sediments, or other pollutants into ditches, storm drains or natural drainage ways.
- I. Trench Bottoms
1. Follow uniform grades. Trench dimensions shall conform to the typical details of the plans, with additional excavation at the couplings to allow full pipe bearing.
- J. Pipe Bearing Surface
1. Dress the trench so that the barrel of the pipe bears evenly for its full length. Dig bell holes at each joint, dimensions of the holes to be sufficient to permit proper jointing.
- K. Excavation Requirements for Structures:
1. General:
 - a. Do not commence excavation for foundations for structures until Geotechnical Engineer approves:
 - 1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.
 - 2) Density and moisture content of site area compacted fill material meets requirements of specifications.
 - 3) Site surcharge or mass fill material can be removed from entire construction site or portion thereof.
 - 4) Surcharge or mass fill material has been removed from construction area or portions thereof.
 - b. Engineer grants approval to begin excavations.
 2. Dimensions:
 - a. Excavate to elevations and dimensions indicated or specified.
 - b. Allow additional space as required for construction operations and inspection of foundations.

- c. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction.
 - d. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings.
- a. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by Geotechnical Engineer.
 - b. Remove unsuitable subgrade soils located below foundations. The bottom of the overexcavation shall be located outside the exterior limits of foundations around the perimeter of structure the following horizontal distance, whichever is greater:
 - 1) Distance equal to depth of overexcavation below bottom of foundations.
 - 2) 5 FT.
 - 3) As directed by Geotechnical Engineer.
 - c. When excavation has reached required subgrade elevations, notify Geotechnical Engineer, who will make an inspection of conditions.
 - 1) If Geotechnical Engineer determines that bearing materials at required subgrade elevations are unsuitable, provide Subgrade Stabilization as specified herein.
4. Level off bottoms of excavations to receive foundations, floor slabs, equipment support pads, or compacted fill.
- a. Remove loose materials and bring excavations into approved condition to receive concrete or fill material.
 - b. Where compacted fill material must be placed to bring subgrade elevation up to underside of construction, scarify existing subgrade upon which fill material is to be placed to a depth of 6 IN and then compact to density stated in this Specification Section before fill material can be placed thereon.
 - c. Do not carry excavations lower than shown for foundations except as directed by Geotechnical Engineer or Engineer.
 - d. If any part of excavations is carried below required depth without authorization, notify Engineer and correct unauthorized excavation as directed. Corrections may include:
 - 1) Under soil supported footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation.
 - a) Concrete fill may be used to bring elevations to proper position.
 - 2) In locations other than those above, including slabs on grade and pile supported foundations, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Geotechnical Engineer.
 - 3) No extra compensation will be made to Contractor for correcting unauthorized excavations.
5. Make excavations large enough for working space, forms, dampproofing, waterproofing, and inspection.
6. Notify Geotechnical Engineer and Engineer as soon as excavation is completed in order that subgrades may be inspected.
- a. Do not commence further construction until subgrade under compacted fill material, under foundations, under floor slabs-on-grade, under equipment support pads, and under retaining wall footings has been inspected and approved by the Geotechnical Engineer as being free of undesirable material, being of compaction density required by this specification, and being capable of supporting the allowable foundation design bearing pressures and superimposed foundation, fill, and building loads to be placed thereon.
 - b. Geotechnical Engineer shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.

- c. Place fill material, foundations, retaining wall footings, floor slabs-on-grade, and equipment support pads as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved.
 - d. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.
7. Dewatering:
- a. Where groundwater is or is expected to be encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope.
 - b. Groundwater shall be maintained at least 3 FT below the bottom of any excavation.
 - c. Review Geotechnical investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
 - d. Employ dewatering specialist for selecting and operating dewatering system.
 - e. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure.
 - f. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
 - 1) Install groundwater monitoring wells as necessary.
 - g. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
8. Subgrade stabilization:
- a. If subgrade under foundations, fill material, floor slabs-on-grade, or equipment support pads is in a frozen, loose, wet, or soft condition before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by Geotechnical Engineer.
 - b. Provide compaction density of replacement material as stated in this Specification Section.
 - c. Loose, wet, or soft materials, when approved by Geotechnical Engineer, may be stabilized by a compacted working mat of well graded crushed stone.
 - d. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids.
 - e. Remove and replace frozen materials as directed by Geotechnical Engineer.
 - f. Method of stabilization shall be performed as directed by Geotechnical Engineer.
 - g. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the Geotechnical Engineer.
9. Do not place floor slabs-on-grade including equipment support pads until subgrade below has been approved, piping has been tested and approved, reinforcement placement has been approved, and Contractor receives approval to commence slab construction.
- a. Do not place building floor slabs-on-grade including equipment support pads when temperature of air surrounding the slab and pads is or is expected to be below 40 DEGF before structure is completed and heated to a temperature of at least 50 DEGF.
10. Protection of structures:
- a. Prevent new and existing structures from becoming damaged due to construction operations or other reasons.
 - b. Prevent subgrade under new and existing foundations from becoming wet and undermined during construction due to presence of surface or subsurface water or due to construction operations.
11. Shoring:
- a. Shore, slope, or brace excavations as required to prevent them from collapsing.
 - b. Remove shoring as backfilling progresses but only when banks are stable and safe from caving or collapse.
 - c. Construct shoring that is required to retain water as part of the dewatering system, using non-permeable details such as interlock sealant for sheet piles.
12. Drainage:

- a. Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures.
 - b. Maintain excavations where foundations, floor slabs, equipment support pads or fill material are to be placed free of water.
 - c. Provide pumping required to keep excavated spaces clear of water during construction.
 - d. Should any water be encountered in the excavation, notify Engineer and Geotechnical Engineer.
 - e. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations.
13. Frost protection:
- a. Do not place foundations, slabs-on-grade, equipment support pads, or fill material on frozen ground.
 - b. When freezing temperatures may be expected, do not excavate to full depth indicated, unless foundations, floor slabs, equipment support pads, or fill material can be placed immediately after excavation has been completed and approved.
 - c. Protect excavation from frost if placing of concrete or fill is delayed.
 - d. Where a concrete slab is a base slab-on-grade located under and within a structure that will not be heated, protect subgrade under the slab from becoming frozen until final acceptance of the Project by the Owner.
 - e. Protect subgrade under foundations of a structure from becoming frozen until structure is completed and heated to a temperature of at least 50 DEGF.
- L. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Floor Slabs, Equipment Support Pads and Piping:
- 1. General:
 - a. Subgrade to receive fill or backfill shall be free of undesirable material as determined by Geotechnical Engineer and scarified to a depth of 6 IN and compacted to density specified herein.
 - b. Surface may be stepped by at not more than 12 IN per step or may be sloped at not more than 2%.
 - c. Do not place any fill or backfill material until subgrade under fill or backfill has been inspected and approved by Geotechnical Engineer or RPR as being free of undesirable material and compacted to specified density.
 - 2. Obtain approval of fill and backfill material and source from Geotechnical Engineer prior to placing the material.
 - 3. Fill and backfill placement:
 - a. Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from Geotechnical Engineer.
 - b. Place fill and backfill material in 8 IN lifts.
 - c. Compact material by means of equipment of sufficient size and proper type to obtain specified density.
 - d. Use hand operated equipment for filling and backfilling within 5 FT of walls and less than 3 FT above pipes.
 - 1) Compaction equipment exceeding 3000 LBS dead weight shall not be used within 5 FT of the wall as a minimum
 - 2) Contractor is responsible for method of compaction so as not to damage wall.
 - e. Use hand operated equipment for filling and backfilling next to walls.
 - f. Do not place fill and backfill when the temperature is less than 40 DEGF and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft.
 - g. Use vibratory equipment to compact granular material; do not use water.
 - 4. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content as required to fill the specified overexcavation to bottom of foundation.
- M. Filling and Backfilling Outside of Structures:

1. This paragraph of this Specification applies to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving.
 2. Provide material as approved by Geotechnical Engineer for filling and backfilling outside of structures.
 3. Fill and backfill placement:
 - a. Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from Geotechnical Engineer.
 - b. Place fill and backfill material to maximum allowable lift thickness indicated in Paragraph 3.5, C, 5, b of this Section.
 - c. Compact material with equipment of proper type and size to obtain density specified.
 - d. Use hand operated equipment for filling and backfilling within 5 FT of walls and less than 3 FT above pipes.
 - 1) Compaction equipment exceeding 3000 LBS dead weight shall not be used within 5 FT of the wall as a minimum
 - 2) Contractor is responsible for method of compaction so as not to damage wall.
 - e. Use only hand operated equipment for filling and backfilling next to walls and retaining walls.
 - f. Do not place fill or backfill material when temperature is less than 40 DEGF and when subgrade to receive material is frozen, wet, loose, or soft.
 - g. Use vibratory equipment for compacting granular material; do not use water.
 4. Backfilling against walls:
 - a. Do not backfill around any part of structures until each part has reached specified 28-day compressive strength and backfill material has been approved.
 - b. Do not start backfilling until concrete forms have been removed, trash removed from excavations, pointing of masonry work, concrete finishing, damp-proofing and waterproofing have been completed.
 - c. Do not place fills against walls until floor slabs at top, bottom, and at intermediate levels of walls are in place and have reached 28-day required compressive strength to prevent wall movement.
 - 1) See Contract Drawings for specific exceptions.
 - d. Bring backfill and fill up uniformly around the structures and individual walls, piers, or columns.
- N. Backfilling Outside of Structures Under Piping or Paving:
1. When backfilling outside of structures requires placing backfill material under piping or paving, the material shall be placed from bottom of excavation to underside of piping or paving at the density required for fill under piping or paving as indicated in this Specification Section.
 2. This compacted material shall extend transversely to the centerline of piping or paving a horizontal distance each side of the exterior edges of piping or paving equal to the depth of backfill measured from bottom of excavation to underside of piping or paving.
 3. Provide special compacted bedding or compacted subgrade material under piping or paving as required by other Specification Sections for the Project.
 4. Do not lay pipe resting on rock, blocking, or other unyielding objects. Where the trench bottom uncovered at subgrade is rock, cut the trench and lay the pipe on an evenly spread and compacted cushion. The cushion shall be at least 4 IN and not more than 8 IN in depth above bottom of trench and shall uniformly support the barrel of the pipe. Construct the cushion from material indicted for use as pipe bedding.
 5. Where the trench bottom is soft and in the opinion of the Engineer, cannot support the pipe, cut the trench as directed and install a suitable cradle. In general, the cradle shall be of pit run sand and gravel, or of small crushed stone or chips.

3.6 GRADING

A. General:

1. Uniformly grade the areas within limits of grading under this Section, including adjacent transition areas.

2. Smooth the finished surfaces within specified tolerance.
 3. Compact with uniform levels or slopes between points where elevations are shown on the Drawings, or between such points and existing grades.
 4. Where a change of slope is indicated on the Drawings, construct a rolled transition section having a minimum radius of approximately 8'0", unless adjacent construction will not permit such a transition, or if such a transition defeats positive control of drainage.
- B. Grading outside building lines:
1. Grade areas adjacent to buildings to achieve drainage away from the structures, and to prevent ponding.
 2. Finish the surfaces to be free from irregular surface changes, and:
 - a. Shape the surface of areas scheduled to be under walks to line, grade, and cross-section, with finished surface not more than 0.10 ft above or below the required subgrade elevation.
 - b. Shape the surface of areas scheduled to be under pavement to line, grade, and cross-section, with finished surface not more than 0.05 ft above or below the required subgrade elevation.

3.7 COMPACTING

- A. Control soil compaction during construction to provide the minimum percentage of density specified for each area as determined according to ASTM D698.
- B. Provide not less than the following maximum density of soil material compacted at plus or minus 2% of optimum moisture content for the actual density of each layer of soil material in place, and as approved by the Engineer.
1. Structures: Compact each layer of fill material or backfill material at 95% of maximum density.
 2. Lawn and Unpaved Areas: Compact each layer of fill material or backfill material at 90% of maximum density.
 3. Walks: Compact each layer of fill material or backfill material at 92% of maximum density or the minimum percent of maximum density as required by the governmental agency having jurisdiction over the work, whichever is more stringent.
 4. Pavements: Compact each layer of fill material or backfill material at 95% of maximum density or the minimum percent of maximum density as required by the governmental agency having jurisdiction over the work, whichever is more stringent.
- C. Moisture control:
1. Where layer of soil material must be moisture-conditioned before compacting, uniformly apply water to layer of soil material to prevent free water appearing on surface during or subsequent to compacting operations.
 2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compacting to the specified density.
 3. Soil material that has been removed because it is too wet to permit compacting may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value as determined by moisture density relation tests approved by the Engineer.

3.8 FIELD QUALITY CONTROL

- A. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA Standards, and state requirements. Where conflict between OSHA and state regulations exists, the more stringent requirements shall apply.
- B. Secure the Engineer's inspection and approval of fill layers before subsequent construction is permitted thereon.
- C. Density testing will be required on all fill layers located under structures and paved surfaces or as directed by the Engineer. All testing shall be in accordance with ASTM D2922
- D. Provide at least the following tests to the approval of the Engineer:

1. At paved areas, at least one field density test for every 2000 sq ft of paved area, but not less than three tests;
 2. In each compacted fill layer, one field density test for every 2000 sq ft of overlaying paved area, but not less than three tests.
- E. If, in the Engineer's opinion based on reports of the testing laboratory, subgrade or fills which have been placed are below specified density, provide additional compacting and testing under the provisions of these Specifications.

3.9 MAINTENANCE

- A. Protection of newly graded areas:
1. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds;
 2. Repair and reestablish grades in settled, eroded, and rutted areas to the specified tolerances.
- B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

END OF SECTION

SECTION 31 23 33
TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavation, trenching, backfilling and compacting for all underground utilities.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 31 23 00 - Earthwork.
 - 2. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
 - 3. Section 33 11 13 - Water Main Construction.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LBF/FT³ (600 kN-M/M<sup>3 - b. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - c. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.</sup>
- B. Qualifications: Hire an independent soils laboratory to conduct in-place moisture-density tests for backfilling to assure that all work complies with this Specification Section.

1.3 DEFINITIONS

- A. Excavation: All excavation will be defined as unclassified.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 2. Submit respective pipe or conduit manufacturer's data regarding bedding methods of installation and general recommendations.
 - 3. Submit sieve analysis reports on all granular materials.
- B. Informational Submittals:
 - 1. Trench shield (trench box) certification if employed:
 - a. Specific to Project conditions.
 - b. Re-certified if members become distressed.
 - c. Certification by registered professional structural engineer, registered in the state where the Project is located.
 - d. Engineer is not responsible to, and will not, review and approve.

1.5 SITE CONDITIONS

- A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving.
 - 1. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property owners.
- B. Provide full access to public and private premises and fire hydrants, at street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.

- C. Protect and maintain bench marks, monuments or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of Owner and controlling agency.
- D. Verify location of existing underground utilities

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Backfill Material:
 - 1. As approved by Engineer.
 - a. Free of rock cobbles, roots, sod or other organic matter, and frozen material.
 - b. Moisture content at time of placement: $\pm 3\%$ of optimum moisture content as specified in accordance with ASTM D698.
- B. Bedding Materials:
 - 1. As approved by the Geotechnical Engineer.
 - 2. Granular bedding materials:
 - a. ASTM D2321 Class 1B.
 - 1) Well-graded crushed stone.
 - 3. Flowable fill:
 - a. Description: Flowable fill shall be a mixture of cement, fly ash, fine sand, water, and air having a consistency which will flow under a very low head.
 - b. Material characteristics:
 - 1) The approximate quantities of each component per cubic yard of mixed material shall be as follows:
 - a) Cement (Type I or II): 50 LBS.
 - b) Fly ash: 200 LBS.
 - c) Fine sand: 2,700 LBS.
 - d) Water: 420 LBS.
 - e) Air content: 10%.
 - 2) Actual quantities shall be adjusted to provide a yield of 1 cubic yard with the materials used.
 - 3) Approximate compressive strength should be 85 to 175 PSI.
 - 4) Fine sand shall be an evenly graded material having not less than 95% passing the No. 4 sieve and not more than 5% passing the No. 200 sieve.
 - 5) Mixing and handling of the material shall be in accordance with Specification Section 03 31 31.

PART 3 - EXECUTION

3.1 GENERAL

- A. Remove and dispose of unsuitable materials as directed by the Owner or Owner's Representative.

3.2 EXCAVATION

- A. Unclassified Excavation: Remove rock excavation, clay, silt, gravel, hard pan, loose shale, and loose stone as directed by Geotechnical Engineer.
- B. Excavation for Appurtenances:
 - 1. 12 IN (minimum) clear distance between outer surface and embankment.
 - 2. See Specification Section 31 23 00 for applicable requirements.
- C. Groundwater Dewatering:

1. Where groundwater is, or is expected to be, encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade to allow subgrade stabilization, pipe, bedding and backfill material to be placed in the dry, and to maintain a stable trench wall or side slope.
2. Groundwater shall be drawn down and maintained at least 3 FT below the bottom of any trench or manhole excavation prior to excavation.
3. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
 - a. Employ dewatering specialist for selecting and operating dewatering system.
4. Keep dewatering system in operation until dead load of pipe, structure and backfill exceeds possible buoyant uplift force on pipe or structure.
5. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
6. Install groundwater monitoring wells as necessary.
7. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
8. Cost of groundwater dewatering shall be included in the lineal foot unit price of the pipe installation.

D. Trench Excavation:

1. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.
 - a. Support existing utility lines [and yard piping] where proposed work crosses at a lower elevation.
 - 1) Stabilize excavation to prevent undermining of existing utility and yard piping.
2. Open trench outside buildings, units, and structures:
 - a. No more than the distance between two manholes, structures, units, or 300 LF, whichever is less.
 - b. Field adjust limitations as weather conditions dictate.
3. Trenching within buildings, units, or structures:
 - a. No more than 100 LF at any one time.
4. Any trench or portion of trench, which is opened and remains idle for [seven] calendar days, or longer, as determined by the Owner, may be directed to be immediately refilled, without completion of work, at no additional cost to Owner.
 - a. Said trench may not be reopened until Owner is satisfied that work associated with trench will be prosecuted with dispatch.
5. Observe following trenching criteria:
 - a. Trench size:
 - 1) Excavate width to accommodate free working space.
 - 2) Maximum trench width at top of pipe or conduit may not exceed outside diameter of utility service by more than the following dimensions:

OVERALL DIAMETER OF UTILITY SERVICE	EXCESS DIMENSION
33 IN and less	18 IN
more than 33 IN	24 IN

- 3) Cut trench walls vertically from bottom of trench to 1 FT above top of pipe, conduit, or utility service.
- 4) Keep trenches free of surface water runoff.
 - a) Include cost in Bid.
 - b) No separate payment for surface water runoff pumping will be made.

E. Flowable Fill:

1. Flowable fill shall be:

- a. Discharged from a mixer by any means acceptable to the Engineer into the area to be filled.
- b. Placed in 4 FT maximum lifts to the elevations indicated.
 - 1) Allow 12 HR set-up time before placing next lift or as approved by the Engineer.
 - 2) Place flowable fill lifts in such a manner as to prevent flotation of the pipe.
2. Flowable fill shall not be placed on frozen ground.
3. Subgrade on which flowable fill is placed shall be free of disturbed or softened material and water.
4. Conform to appropriate requirements of Specification Section 31 23 00.
5. Flowable fill batching, mixing, and placing may be started if weather conditions are favorable, and the air temperature is 34 DEGF and rising.
6. At the time of placement, flowable fill must have a temperature of at least 40 DEGF.
7. Mixing and placing shall stop when the air temperature is 38 DEGF or less and falling.
8. Each filling stage shall be as continuous an operation as is practicable.
9. Prevent traffic contact with flowable fill for at least 24 HRS after placement or until flowable fill is hard enough to prevent rutting by construction equipment.
10. Flowable fill shall not be placed until water has been controlled or groundwater level has been lowered in conformance with the requirements of the preceding Groundwater Dewatering paragraph in PART 3 of this Specification Section.

3.3 PREPARATION OF FOUNDATION FOR PIPE LAYING

- A. Over-Excavation:
 1. Backfill and compact to 90% of maximum dry density per ASTM D698.
 2. Backfill with granular bedding material as option.
- B. Rock Excavation:
 1. Excavate minimum of 6 IN below bottom exterior surface of the pipe or conduit.
 2. Backfill to grade with suitable earth or granular material.
 3. Form bell holes in trench bottom.
- C. Subgrade Stabilization:
 1. Stabilize the subgrade when directed by the Owner.
 2. Observe the following requirements when unstable trench bottom materials are encountered.
 - a. Notify Owner when unstable materials are encountered.
 - 1) Define by drawing station locations and limits.
 - b. Remove unstable trench bottom caused by Contractor failure to dewater, rainfall, or Contractor operations.
 - 1) Replace with subgrade stabilization with no additional compensation.

3.4 BACKFILLING METHODS

- A. Do not backfill until tests to be performed on system show system is in full compliance with specified requirements.
- B. Carefully Compacted Backfill:
 1. Furnish where indicated on Drawings, specified for trench embedment conditions and for compacted backfill conditions up to 12 IN above top of pipe or conduit.
 2. Comply with the following:
 - a. Place backfill in lifts not exceeding 8 IN (loose thickness).
 - b. Hand place, shovel slice, and pneumatically tamp all carefully compacted backfill.
 - c. Observe specific manufacturer's recommendations regarding backfilling and compaction.
 - d. Compact each lift to specified requirements.
- C. Common Trench Backfill:
 1. Perform in accordance with the following:
 - a. Place backfill in lift thicknesses capable of being compacted to densities specified.
 - b. Observe specific manufacturer's recommendations regarding backfilling and compaction.

- c. Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.

D. Water flushing for consolidation is not permitted.

3.5 COMPACTION

A. General:

- 1. Place and assure bedding, backfill, and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.
- 2. In no case shall degree of compaction below minimum compactions specified be accepted.

B. Compaction Requirements:

- 1. Unless noted otherwise on Drawings or more stringently by other Specification Sections, comply with following minimum trench compaction criteria.
 - a. Bedding material:

LOCATION	SOIL TYPE	COMPACTION DENSITY
All locations	Cohesionless soils	75% relative density by ASTM D4253 and ASTM D4254

- b. Carefully compacted backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
All applicable areas	Cohesive soils	95% of maximum dry density by ASTM D698
	Cohesionless soils	75% relative density by ASTM D4253 and ASTM D4254

- c. Toe drain bedding and backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
All locations	Cohesionless soils	60% relative density by ASTM D4253 and ASTM D4254

- d. Common trench backfill:

LOCATION	SOIL TYPE	COMPACTION DENSITY
Under pavements, roadways, surfaces within highway right-of-ways	Cohesive soils	95% of maximum dry density by ASTM D698
	Cohesionless soils	60% of relative density by ASTM D4253 and ASTM D4254
Under turfed, sodded, plant seeded, nontraffic areas	Cohesive soils	85% of maximum dry density by ATM D698
	Cohesionless soils	40% of relative density by ASTM D4253 and ASTM D4254

3.6 FIELD QUALITY CONTROL

A. Testing:

- 1. Perform in-place moisture-density tests as directed by the Owner.
- 2. Perform tests through recognized testing laboratory approved by Owner.
- 3. Costs of "Passing" tests paid by Owner.
- 4. Perform additional tests as directed until compaction meets or exceeds requirements.
- 5. Cost associated with "Failing" tests shall be paid by Contractor.

6. Reference to Engineer in this Specification Section will imply Geotechnical Engineer when employed by Owner and directed by Engineer to undertake necessary inspections as approvals as necessary.
7. Assure Owner has immediate access for testing of all soils related work.
8. Ensure excavations are safe for testing personnel.

END OF SECTION



DIVISION 33

UTILITIES



SECTION 33 11 13
WATER MAIN CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Coordination and interface with existing facilities and utilities.
 - 2. Connections to existing water mains.
 - 3. Testing, flushing and disinfection.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 32 91 13 - Topsoiling and Finished Grading.
 - 2. Section 33 12 19 - Fire Hydrant.
 - 3. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
 - 4. Section 40 05 51 - Valves - Basic Requirements.
 - 5. Section 40 05 61 - Gate Valves.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Water Work Association (AWWA):
 - a. B300, Standard for Hypochlorites.
 - b. B301, Standard for Liquid Chlorine.
 - c. C651, Standard for Disinfecting Water Mains.

1.3 SUBMITTALS

- A. Submit results of the leakage tests, identifying the specific length of pipe tested, the test pressure, the duration of test and the amount of leakage.
- B. Submit satisfactory bacteriological test reports on disinfection requirements.
- C. Submit qualifications for lab performing disinfection analysis.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe: Refer to Specification Section 40 05 00.
- B. In-Line Valves:
 - 1. Refer to Specification Section 40 05 51, Specification Section 40 05 52, and Specification Section 40 05 61.
 - 2. Provide adjustable valve boxes.
 - a. Include price of valve boxes in price of valve installed complete.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install water main to the line and grade on the Drawings.
 - 1. Water mains to be staked at a minimum 100 FT interval with depth of cuts monitored.
- C. Field verify depth of utilities that will be crossed.
 - 1. Adjust water main elevation as required during construction.

2. No separate payment will be made for field verification or adjustment of main depths as required.
- D. Contractor will restore all existing structures or services damaged by Contractor's operations at no cost to Owner.

3.2 INTERRUPTION OF SERVICE

- A. Interruption of service to water users shall not exceed 4 HRS.
1. Notify property owners of interruption a minimum of 24 HRS in advance.

3.3 UNDERGROUND SERVICES

- A. Notify utility representative prior to construction to obtain available information on location of existing utilities.
1. Contractor shall be responsible for locating all utilities.

3.4 DRIVEWAY REMOVAL AND REPLACEMENT

- A. All Portland cement concrete and asphalt noted for removal and replacement shall be cut prior to removal.
1. Cut by sawing, vertical cut to be 1 IN minimum.
 2. The remaining depth of section may be broken out in a manner subject to Engineers approval.
 3. Width of section removed to be either a width not greater than the outside diameter of the water main plus 4 FT-0 IN or broken out to the nearest joint.
- B. Replace Portland cement concrete and asphalt equal to or better than original paving plus 2 IN.
- C. Debris resulting from the above operations shall be removed and hauled as directed by the Engineer.
- D. Include driveway removal and replacement in cost of the bid unit price of the water main.

3.5 GRAVEL SURFACED DRIVES AND ROADWAYS

- A. Restore all damaged gravel surfaced drives and roadways to a condition equal to or better than original.
1. Payment to be at bid unit price for this item.
 2. Replacement gravel gradation.

3.6 PROTECTION OF EXISTING UTILITIES

- A. Contractor to verify the location of all underground utilities.
1. Omission from, or the inclusion of utility locations on the plans is not to be considered as the nonexistence of or a definite location of existing underground utilities.
- B. A representative of the underground utilities shall be notified 24 HRS in advance of crossings.

3.7 CONNECTIONS TO EXISTING WATER MAINS

- A. Make connections to existing water mains as shown on Drawings, by attaching to existing or changed fitting.
1. Cost for making connections shall include cost of all fittings including flexible couplings, and shall be included in the bid unit price of the water main.
- B. Where the connection is made to an existing water main which can be adequately isolated from the distribution system, it shall be termed a "dry connection."
- C. Contractor is responsible for controlling and disposing of water in the trench at no additional cost to the Owner.

3.8 SEWER CROSSINGS

- A. Water mains crossing house sewers, storm sewers or sanitary sewers shall be laid to provide a vertical separation of at least 18 IN between the bottom of the water main and the top of the sewer, whenever possible.
 - 1. A water main may be laid closer than 10 FT if the crown of the sewer is at least 18 IN below the water main invert.
 - 2. In the event 18 IN of vertical separation cannot be provided at a sewer crossing, the sewer shall be removed for a distance of 10 FT on each side of the water main and replaced with one 20 FT length of ductile iron pipe of the same size.
- B. Concrete collars shall be provided at each end of the ductile iron pipe to connect to the existing sewer pipe as shown on the Drawings.
- C. Payment for crossings shall be included in the bid unit price of the water main.

3.9 TREES

- A. Do not remove trees without written instructions from the Engineer unless tree removal is shown on drawings.
 - 1. No separate payment will be made for tree removal and the cost shall be included in the bid unit price for transmission main.

3.10 FENCES, SIGNS, MAILBOXES, ETC.

- A. Restore all damaged fences, signs, mailboxes, etc., to their original conditions.
 - 1. No separate payment will be made for these items.

3.11 FIELD QUALITY CONTROL

- A. Sealing, Flushing, and Disinfection of Potable Water Systems:
 - 1. Maintain interior of all pipes, fittings and other accessories free from dirt and foreign material at all times.
 - a. If, in the opinion of the Engineer, the pipe contains dirt that will not be removed by flushing, the pipe interior shall be cleaned and swabbed with bactericidal solution.
 - b. At close of day's work or whenever workmen are absent from jobsite, plug, cap or otherwise provide watertight seal from open ends of pipe to prevent ingress of foreign material.
 - c. If water is in trench, seal shall remain in place until trench is pumped dry.
 - 2. After favorable performance of pressure test and prior to final acceptance, thoroughly flush the entire potable water piping system and perform disinfection as prescribed.
 - a. Perform all work including preventative measures during construction in full compliance to AWWA C651.
 - 3. Flush each segment of the system to provide a flushing velocity of not less than 2.5 FT per second.
 - 4. Drain flushing water to location approved by the Owner.
 - 5. Perform disinfection using one of the following forms:
 - a. Application of chlorine gas-water mixture by means of solution-feed chlorinating device.
 - 1) Liquid chlorine shall comply with AWWA B301.
 - b. Application of calcium hypochlorite, or sodium hypochlorite.
 - 1) Chlorine compounds shall comply with AWWA B300.
 - 6. Disinfect pipe with chlorinated water as per AWWA C651.
 - a. Method of application of chlorine shall be by continuous feed method or slug method.
 - b. During disinfection procedure, ensure that initial and residual chlorine concentrations meet AWWA C651 requirements by testing by an approved method as directed by the Owner.
 - c. Cost of testing shall be included in the Bid Unit Price for water mains and no separate payment will be made for this item.
 - 7. Tag the system during the disinfection procedure.

8. Following disinfection for required contact period, neutralize chlorine residual in water by treating with reducing agent.
 - a. Refer to AWWA C651.
 - b. Flush all treated water from pipeline at its extremities until replacement water throughout pipe, upon test is proved comparable in quality to water in existing system.
 - c. Take two samples to test for bacteriological quality as directed by Engineer.
 - d. Repeat disinfection procedure until two satisfactory results are obtained.
 - e. Quality of water delivered by the new water main to remain satisfactory for a minimum period of two days.
9. Secure satisfactory bacteriological reports on samples from the system.
 - a. Ensure all sampling and testing procedures are in full compliance to AWWA C651, and applicable requirements of the location the Site is in.
 - 1) No separate payment will be made for this item.
10. The Owner will provide the water required to fill the main initially and will pay for the water required to flush the main once.
 - a. Filling and flushing shall be performed during periods of low usage, between the hours of midnight and 4:00 AM.
 - b. Flushing water will be based on a maximum of 8 HRS total.
 - c. Any additional refilling or reflushing to be at the Contractor's expense at the City's commercial water rates.

END OF SECTION

SECTION 33 16 23
LAMASCO TANK REHABILITATION AND IMPROVEMENTS
STEEL TANK – GLASS COATED

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. This specification covers, the retrofit of a glass lined tank corrosion protection system (including removal of the existing protection system), miscellaneous tank repairs, preparation of surfaces, performance and completion of touch up work of all deteriorated interior surfaces of a 189,000 gallon standpipe water storage tank located along KY Highway 93 in Lamasco, Lyon County, Kentucky.
2. The Aquastore glass lined standpipe was manufactured in 1986 by A.O. Smith Harvestore Products, Inc. The following are some general design criteria for the tank:

Overall Height:	Approximately 90'
Shape:	Cylinder
Standpipe Diameter:	20'-0"
Head Range:	83'-0"
Capacity:	189,000 gallons

3. The CONTRACTOR shall be responsible for all costs associated with sampling, worker protection, environmental pollution control, handling of debris, laboratory analysis, waste disposal, in addition to those items listed in the following specification.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 03 - Concrete.
2. Section 31 23 00 - Earthwork.
3. Division 33 – Utilities.
4. Division 40 - Process Interconnections.
5. Section 46 41 00 - Mixers.

1.2 WORK INCLUDED

- A. Coordination with Owner for isolating and draining of the tank.
- B. Preparation of surfaces, which are to receive sealing finishes.
- C. Collection, handling and disposal of debris.
- D. Removal of the existing corrosion protection system
- E. Tank repairs (including installation of corrosion protection system).
- F. Finish surfaces.
- G. Testing and cleaning.
- H. Installation of mixing system.
- I. Construction of 8-inch bypass line.
- J. Assembly and Installation of altitude valve, flush hydrant, and check valve.
- K. Grouting of Tank Base.
- L. Replacement of manway gaskets and bolts.
- M. Roof screen replacement.

N. Safety climb and hardware replacement.

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. American Institute of Steel Construction (AISC).
2. American Iron and Steel Institute (AISI).
3. American Society of Civil Engineers (ASCE):
 - a. 7, Minimum Design Loads for Buildings and Other Structures.
4. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength.
 - c. A992, Standard Specification for Structural Steel Shapes.
 - d. A1008, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - e. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - f. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - g. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
5. American Water Works Association (AWWA):
 - a. D103, Standard for Factory-Coated Bolted Steel Tanks for Water Storage.
6. Code of Federal Regulations (CFR):
 - a. Food and Drug Administration (FDA):
 - 1) Title 21, Food and Drugs.
7. National Sanitation Foundation International (NSF):
 - a. 61, Drinking Water System Component.
8. Occupational, Safety and Health Administration (OSHA).
9. Society of Automotive Engineers (SAE):
 - a. J429, Mechanical and Material Requirements for Externally Threaded Fasteners.
10. Society for Protective Coatings/NACE International (SSPC/NACE):
 - a. SP 10/NACE No. 2, Near-White Blast Cleaning.

B. Qualifications:

1. Coating manufacturer's technical representative shall be a NACE Certified Coatings Inspector, Level 3 minimum.
2. Applicators shall have minimum of 10 years of experience in application of similar products on similar project.
 - a. Provide references for minimum of three different coating rehabilitation projects completed in last five years with similar scope of work.
 - b. Include name and address of project, size of project in value (coating) and contact person.
3. NACE inspector – This service will be provided by the Owner's representative.
4. Furnish coating through one manufacturer unless noted otherwise.

C. Material shall not be thinned unless approved, in writing, by coating manufacturer's technical representative.

1.4 SUBMITTALS

A. Shop Drawings:

1. Product technical data including:

- a. Before any materials are delivered to the job site, submit to the Consultant a complete list of all materials proposed to be furnished including quantities, types and descriptions of paint for each part of the project. Material list shall refer to the specified paint systems and the paint schedule for each paint product proposed to be used. In cases where paint materials other than those described in the Specifications are proposed, a materials list will not be considered as acceptance of such substitute materials; further data will be required as specified herein.
- b. Acknowledgement that product submitted meet requirements of standards referenced.
- c. Manufacturer's installation instructions.
- 2. Manufacturer's descriptive data describing each product to include solids by volume, performance data and manufacturer's recommendations for mixing, thinning and curing.
- 3. Manufacturer's certified test reports confirming compliance with the specified performance requirements under Section 2.01.
- 4. Coating information.
 - a. Color cards showing color availability for each finish coat.
- 5. Certifications:
 - a. Certificates of compliance with standards specified for all major components incorporated into work.
- 6. Test reports.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to job site in factory-sealed, original-labeled containers, as applicable.
- B. Store materials in a protected area, at temperatures in accordance with manufacturer's recommended temperatures.

1.6 ENVIRONMENTAL CONDITIONS

- A. Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above the minimum shown on the manufacturer's product data sheets.
- B. Provide minimum 25-foot candles (270 lx.) of lighting on surfaces to be finished.
- C. The crew will always have on site, certificated mil gauges, and environmental monitoring gauges.
- D. Ventilation
 - 1. Ventilation is essential to remove vapors during application and curing of coatings.
 - 2. Ventilation shall be exhausted from lowest portion of tank with top openings kept clear.
 - 3. During coating applications the capacity of the ventilating fans shall be at least 400 cfm per gallon of coating applied per hour.
 - 4. The ventilation requirements are to ensure proper curing of the applied coatings and are not to be taken as requirements to ensure worker safety.
 - 5. Following the application of the final interior coating the tank shall be force ventilated by mechanical means from the lowest possible point for a minimum of 48 hours, ventilation shall be such that it creates a total turn-over on the interior of the tank a least once per hour.
- E. Apply paints only when temperature of surfaces to be painted and surrounding air temps are between 55- and 90-degrees Fahrenheit unless otherwise permitted by paint manufactures printed instructions.
- F. Application of coatings will not be permitted in snow, rain, fog, mist or when the relative humidity exceeds 85%; or when the surface temp of substrate is less than 5 degrees Fahrenheit above the dew point; or to damp or wet surfaces.
- G. Painting will not be allowed during periods of inclement weather.

1.7 PROTECTION AND SAFETY PRECAUTIONS

- A. All of the CONTRACTOR'S activities shall comply with federal, state and local requirements for environmental pollution control.

- B. Plug and protect the tank inlet/outlet and overflow pipe at all times during the execution of the work.
- C. Adequately protect the level controls from damage. Repair damage as a result of inadequate or unsuitable protection.
- D. All of the CONTRACTOR'S activities and equipment used on the job site must be in compliance with federal, state and local law. Defective or substandard equipment shall not be used. Hoists, ladders, electrical equipment, scaffolding and hand or powered tools must meet safety standards.
- E. Inspect all tank surfaces, ladders, and rigging connections before they are used. Any excessively deteriorated parts shall be repaired or replaced before use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Provide products manufactured by the following:
 - a. Rust-Oleum Industrial
 - b. KY Glass Lined Tanks
 - c. Specified accepted products are outlined in section 2.2.
 - 2. Alternate products may be considered, Contractor shall submit in writing detailed explanation for requesting product change, along with pricing of product. If product is accepted all savings shall revert to owner. Contractor shall bear any, and all costs associated with evaluation of product by consultant, which may include but not limited to research, and testing by independent laboratories for product performance, and equality of those specified.
 - 3. Only approved thinners from coatings manufacture shall be always used.

2.2 MATERIALS

- A. All materials utilized for the completion of surface repair work and installation of the anti-corrosion system shall be of non-corrosive materials, suitable for use in potable water applications.

2.3 COMPATIBILITY

- A. The Contractor shall be responsible for the compatibility of all paints used in the Work. A compatible paint will be considered a paint which precludes adverse effects related to bonding, drying delamination, scaling, lifting, and bleeding.
- B. In cases where shop-applied primers and coatings on materials and equipment furnished by suppliers are products different from those described in the Specifications, the Contractor shall verify compatibility with the specified field-applied coating system.
- C. Where thinning is necessary, only the products of the manufacturer furnishing the paint, and products for thinning purposes only, will be allowed.

2.4 MATERIAL PREPARATION

- A. Mix and thin materials according to manufacturer's latest printed instructions.
- B. Do not use materials beyond manufacturer's recommended shelf life.
- C. Do not use mixed materials beyond manufacturer's recommended pot life.

PART 3 - EXECUTION

3.1 RESIDENT PROJECT REPRESENTATIVE (RPR) INSPECTION

1. Oversight of the work will be performed by the Engineer RPR, to be a NACE-certified Inspector, or an NACE-certified Inspector-in-Training under the supervision of a NACE-certified Senior Inspector.

3.2 PRE-WORK INSPECTION

- A. Examine surfaces to be repaired and report conditions that would adversely affect appearance or performance of the proposed systems, and which cannot be put into an acceptable condition by preparatory work.
- B. Do not proceed with work until authorization to proceed is given by the OWNER.

3.3 SURFACE PREPARATION

- A. Interior Surface Preparation:
 1. Remove all visible oil, wax, grease, soil, dirt and other soluble contaminants. All surfaces shall be cleaned by power washing and/or use of non-powered hand tools, removing all scale, rust, dirt, or foreign matter.
 2. The interior shall be high pressure washed to remove all loose, or failed plate sealer, rust nodes and rust.
 3. Once the surface has been prepared, all remaining loose sealer shall be removed by hand or power tool. Care is to be taken as to not damage any of the intact glass surfaces.
 4. All rusted areas are to be power tool cleaned to a SSPC-SP3(wire cup brushes are not allowed). Rusted areas are to be chased to a point where the solid glass coating is still intact.
 5. All prepared areas shall be with sealed products listed in article 3.4.
- B. All particles shall be collected and removed from the tank site by the CONTRACTOR in accordance with federal, state and local requirements.
- C. All dust, debris and contaminants shall be removed from the surface prior to sealing.

3.4 REPAIRS

- A. Immediately after cleaning the tank interior surfaces, an inspection shall be made by the ENGINEER/OWNER or Representative in the presence of the CONTRACTOR to determine if any additional repair items will be authorized by the OWNER as additional work to be paid for at the Unit Bid prices for tank repair.
- B. All repairs shall be made in a manner to affect a permanent repair. Only qualified personnel shall perform WORK. Care shall be taken to avoid damage to seams, plates and pipe connections, which could result in leakage. The CONTRACTOR shall guarantee the water tank to be free from leakage upon completion of his work.

3.5 SEALER

- A. Original Sealer from manufacturer is the preferred sealer.
 1. Sealer shall be applied to a clean dry surface, to a minimum of a ¼-in bead along all seams.
 2. Larger areas may need to be trowel graded to a point where the new product meets the intact glass. The overlap onto the glass should be a minimum of ½-in in all directions, to create a continuous surface
- B. CIM Industries 1061 Potable Water
 1. Following cleaning and prior to application apply the supplied bonding agent for the product and allow to flash off for a few moments.
 2. Apply sealer to a clean dry surface, to a minimum of a ¼-in bead along all seams.
 3. Larger areas may need to be trowel graded to a point where the new product meets the intact glass. The overlap onto the glass should be a minimum of ½-in in all directions, to create a continuous surface

3.6 THICKNESS AND SPREADING RATES

- A. Minimum dry mil thickness per coat (MDMTPC) and/or spreading rates in square feet per gallon shall be governed by the manufacturer's current data sheets or literature containing recommendations or instructions regarding these values. These recommended dry mil thickness and/or spreading rate values will be considered requirements to be met same as if set out herein these Specifications and Contract Documents and must be included with material list submittals before Consultant grants approval to use any paint materials. Do not exceed manufacturer's recommended coverage rates.
- B. The number of coats to be applied are specified herein and shall govern. Where the total dry film thickness is specified, this thickness shall govern over the MDMTPC

3.7 ANTI-CORROSION SYSTEM

- A. The Cathodic protection (anti-corrosion) system for glass-lined water storage tanks with concrete foundations shall be installed as per the Plan Drawings.
- B. All materials utilized for the anti-corrosion system shall be suitable for potable water applications.
- C. Consult glass lined tank manufacturer for required procedures for installation of all equipment and penetrations made through the tank sidewalls.

3.8 INSPECTION

- A. The CONTRACTOR shall maintain a contemporaneous daily inspection log to be used as a permanent record for the project and to compliment the periodic inspections by the OWNER'S representative. The contractor's inspection log shall include:
 - 1. Daily record of materials stored and used on-site.
 - 2. Ambient conditions.
 - 3. Production record: personnel on-site, hours worked, location of surface preparation and repaired areas and materials used at each work area.
- B. The CONTRACTOR'S daily inspection log shall be made available at any time to the ENGINEER / OWNER or their representative and an updated copy shall be included with each pay request.

3.9 ACCEPTANCE OF WORK

- A. All surface preparation and repairs shall be approved by the OWNER before tank is filled and payment is made to the CONTRACTOR. The CONTRACTOR shall request acceptance of all repair work, and shall correct work that is not acceptable and request re-inspection. All rigging to remain in place and CONTRACTOR shall aid in use of rigging for all inspections by OWNER'S Representative.

3.10 CLEANING AND DISINFECTION

- A. Cleaning: After completing the WORK, remove all scaffolding, planks, tools, rags, media and all other materials not part of the structural or operating facilities of the tank. Thoroughly clean and wash the walls, floor, roof and operating facilities of the tank by use of a high-pressure water jet, sweeping, scrubbing or other effective means. Flush out and otherwise remove from the tank all water, debris, and foreign materials accumulated during this cleaning operation. Thoroughly clean and flush out the bottom of the tank and the inlet/outlet pipe.
- B. Disinfecting: After cleaning, but before placing it in service, disinfect the inside of the tank in accordance with AWWA Standard C 652-latest edition, Section 4.3 by Chlorination Method 2.
 - 1. Jet wash the interior of the tank with a chlorine solution of minimum 200 PPM.
 - a. Use a chlorine product free of acid components.
 - b. Provide the mixing water and remove the chlorine solution that accumulates in the bottom of the tank the same workday it is applied.
 - c. Rinsing with water is not required.

- C. Sampling and Testing: After the chlorination is complete and before the tank is placed in service, water from the full facility shall be sampled and tested in accordance with AWWA Standard C652-latest edition, Section 4.4 & Section 5.1 Bacteriological.
- D. Chemicals and Equipment: Provide all necessary chlorine bearing compounds, solution tank, pumps, hoses, mops and other items required for cleaning, disinfection and flushing operations.
- E. Disposal of Heavily Chlorinated: Water from the disinfection process shall be in accordance with the KY EPPC Division of Water Requirements.
- F. Samples: Two or more successive sets of bacteriological samples, taken at 24-hour intervals, shall be taken and reported (using the most expedient method) to the Division of Water following disinfection.

3.11 CLEAN-UP

- A. Remove all debris and leave site in pre-project condition.

3.12 GUARANTEE

- A. The CONTRACTOR shall guarantee his work for a period of two years to the extent that he shall repair any defects due to faulty workmanship or materials that may appear on the structure during this period.
- B. A first anniversary inspection shall be conducted by the OWNER or Representative with the CONTRACTOR present in accordance with AWWA Standard D102-latest edition, Section 5.2.

END OF SECTION

SECTION 33 16 24
JACK THOMASON TANK REHABILITATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. This specification covers repair, preparation of surfaces, performance and completion of painting of all interior and exterior surfaces of a 100,000 gallon elevated water storage tank located in Eddyville, Lyon County, Kentucky.
2. The elevated steel tank was erected in 1995. The following are some general design criteria for the tank:

Overall Height:	145'	
Shape:		Double Ellipsoid
Bowl Diameter:	25'-0"	
Head Range:	28'-7"	
Capacity:	100,000 gallons	

3. The intent of the exterior cleaning specification is to sweep blast all surfaces by blasting in accordance with SSPC-SP7. Rusted areas will be blasted to a commercial finish in accordance with SSPC-SP6.
4. The intent of the interior surface preparation is to remove all of the existing coating by blasting to a near-white metal finish in accordance with SSPC-SP10.
5. The CONTRACTOR shall be responsible for all costs associated with sampling, worker protection, environmental pollution control, handling of debris, laboratory analysis and waste disposal.

1.2 WORK INCLUDED

- A. Preparation of surfaces, which are to receive finishes.
- B. Collection, handling and disposal of debris.
- C. Tank repairs.
- D. Finish surfaces.
- E. Testing and cleaning.
- F. Replacement of manway.
- G. Level indicator replacement.
- H. Installation of stiffener ring.
- I. Grouting of Tank Base.
- J. Roof screen replacement.
- K. Safety climb and hardware replacement.

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. American Society of Civil Engineers (ASCE):
 - a. 7, Minimum Design Loads for Buildings and Other Structures.
2. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A307, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

- c. A570, Hot-Rolled Sheet and Strip, Structural Quality.
- 3. American Water Works Association (AWWA):
 - a. C652, Standard for Disinfection of Water Storage Facilities.
 - b. D103, Standard for Factory-Coated Bolted Steel Tanks for Water Storage.
- 4. American Petroleum Institute (API):
 - a. 12B, Bolted Tanks for Storage of Production Liquids.
- 5. National Sanitation Foundation International (NSF).
- 6. Occupational, Safety and Health Administration (OSHA).
- 7. Steel Structures Painting Council Standards/NACE International (SSPC/NACE):
 - a. SP 10/NACE No. 2, Near-White Blast Cleaning.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that product submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 2. Manufacturer's descriptive data describing each product to include solids by volume, performance data and manufacturer's recommendations for mixing, thinning and curing.
 - 3. Manufacturer's certified test reports confirming compliance with the specified performance requirements under Section 2.01.
 - 4. Coating information.
 - a. Color cards showing color availability for each finish coat.
 - 5. Certifications:
 - a. Certificates of compliance with standards specified for all major components incorporated into work.
 - 6. Test reports.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to job site in factory-sealed, original-labeled containers.
- B. Store materials in a protected area at a temperature between 35° F and 110° F.
- C. Steel Members:
 - 1. Handle and store steel members above ground on platforms, skids, or other supports.
 - 2. Keep members free of dirt, grease and other foreign material.

1.6 ENVIRONMENTAL CONDITIONS

- A. Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above the minimum shown on the manufacturer's product data sheets.
- B. Provide minimum 25-foot candles (270 lx.) of lighting on surfaces to be finished.

1.7 PROTECTION AND SAFETY PRECAUTIONS

- A. Take all precautions necessary to avoid adversely affecting the surrounding environment with blast media or paint particle drift or overspray. All of the CONTRACTOR'S activities shall comply with federal, state and local requirements for environmental pollution control.
- B. Plug and protect the tank inlet/outlet and overflow pipe at all times during the execution of the work to prevent damage and the entrance of blast media and debris.
- C. Adequately protect the level controls from paint and damage. Repair damage as a result of inadequate or unsuitable protection.
- D. All of the CONTRACTOR'S activities and equipment used on the job site must be in compliance with federal, state and local law. Defective or substandard equipment shall not be used. Hoists, ladders, electrical equipment, scaffolding and hand or powered tools must meet safety standards.

- E. Inspect all tank surfaces, ladders, and rigging connections before they are used. Any excessively deteriorated parts shall be repaired or replaced before use.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Provide products manufactured by the following:
 - a. Rust-Oleum Industrial Mark Sholtes 502-451-2226
 - b. Carboline Joel Womack 502-648-7802
 - c. Tnemec Nex Gen TN
 - 2. Specified accepted products are outlined in section 2.2.
- B. Equivalent products by other manufacturers are acceptable, providing they meet or exceed all performance criteria of the specified materials. No products shall be considered that would decrease film thicknesses or offer a change in generic type of coating specified.
- C. Before submitting a bid based on a coating other than the specified system, submit to the Owner for approval at least 10 days prior to the bid date all pertinent data on the substitution coating including performance data as determined by an independent testing laboratory.
- D. Products for each specified function and system shall be of a single manufacturer.

2.2 MATERIALS

A. Interior Coating System

A. Rust-Oleum Industrial

- 1. Prime Coat: Immediately after blasting and before any rusting occurs (12 hours maximum) apply Rust-Oleum W 9200 to a DFT of 5.0-8.0 Mils - White
- 2. Seams: All weld seams shall receive an additional roll coat to a DFT of 5.0-8.0 Mils prior to finish application
- 3. Intermediate Coat: Rust-Oleum W 9200 to a DFT of 5.0-8.0 Mils – Marlin Blue
- 4. Finish Coat: Rust-Oleum W 923 to a DFT of 5.0-8.0 Mils - White

*NOTE: Total DFT shall not be less than 15 Mils not including the weld seams which shall be a minimum of 5 mils greater.

*NOTE: The roll coat is to be applied prior to the application of the finish coat. A minimum of one full day (24 hours) shall pass prior to the application of the finish coat.

B. Carboline Co.

- 1. Prime Coat: Immediately after blasting and before any rusting occurs (12 hours maximum) apply Carboguard 891 VOC to a DFT of 5.0-8.0 Mils - White
- 2. Seams: All weld seams shall receive an additional roll coat to a DFT of 5.0 mils prior to finish application
- 3. Intermediate Coat: Carboguard 891 VOC to a DFT of 5.0-8.0 Mils - Gray
- 4. Finish Coat: Carboguard 891 VOC to a DFT of 5.0-8.0 Mils - Gray

*NOTE: Total DFT shall not be less than 15 Mils not including the weld seams which shall be a minimum of 5 Mils greater.

*NOTE: The roll coat is to be applied prior to the application of the finish coat. A minimum of one full day (24 hours) shall pass prior to the application of the finish coat.

C. Tnemec Co

- 1. Prime Coat: Immediately after blasting and before any rusting occurs (12 hours maximum) apply Tnemec Series 20 (or 21) to a DFT of 4.0-6.0 Mils - White
- 2. Seams: All weld seams shall receive an additional roll coat to a DFT of 5.0 Mils prior to finish application
- 3. Intermediate Coat: Tnemec Series 20 (or 21) to a DFT of 4.0-6.0 Mils - Beige
- 4. Finish Coat: Tnemec Series 20 (or 21) to a DFT of 4.0-6.0 Mils - White

*NOTE: Total DFT shall not be less than 15 Mils not including the weld seams which shall be a minimum of 5 mils greater.

*NOTE: The roll coat is to be applied prior to the application of the finish coat. A minimum of one full day (24 hours) shall pass prior to the application of the finish coat.

D. Exterior Coating System

1. Rust-Oleum Industrial Noxyde Overcoat
 - a. Coating shall be spray applied as required by supplier.
 - b. Prime Coat: Rust-Oleum Mathys Noxyde
 - c. Spot Priming: Rust-Oleum 9100 Epoxy to a DFT of 3 Mils – White
 - d. Intermediate: Full Coat Noxyde to a minimum DFT of 7 Mils – Color may vary)
 - e. Secondary Coat: Full Coat Noxyde to a minimum DFT of 7 Mils – Color may vary)
 - f. Noxyde shall be applied at approximately 14 Mils wet to achieve 7 Mils DFT
 - g. Finish Coat: Rust-Oleum 9800 minimum 3-5 Mils DFT

2.3 COMPATIBILITY

- A. The Contractor shall be responsible for the compatibility of all paints used in the Work. A compatible paint will be considered a paint which precludes adverse effects related to bonding, drying delamination, scaling, lifting, and bleeding.
- B. In cases where shop-applied primers and coatings on materials and equipment furnished by suppliers are products different from those described in the Specifications, the Contractor shall verify compatibility with the specified field-applied coating system.
- C. Where thinning is necessary, only the products of the manufacturer furnishing the paint, and products for thinning purposes only, will be allowed.

2.4 MATERIAL PREPARATION

- A. Mix and thin materials according to manufacturer's latest printed instructions.
- B. Do not use materials beyond manufacturer's recommended shelf life.
- C. Do not use mixed materials beyond manufacturer's recommended pot life.

PART 3 - EXECUTION

3.1 RESIDENT PROJECT REPRESENTATIVE (RPR) INSPECTION

- A. Oversight of the work will be performed by the Engineer RPR, to be a NACE-certified Inspector, or an NACE-certified Inspector-in-Training under the supervision of a NACE-certified Senior Inspector.

3.2 PRE-WORK INSPECTION

- A. Examine surfaces to be coated and report conditions that would adversely affect appearance or performance of coating systems and which cannot be put into an acceptable condition by preparatory work specified in Section 3.02.
- B. It shall be the contractor's responsibility to determine the most appropriate means for applying coatings to the exterior and interior of the tank (with exception of the specified roll coat to all interior welds).
- C. Do not proceed with field surface preparation and coating application until surface is acceptable or authorization to proceed is given by the OWNER.Sidewall structure.

3.3 SURFACE PREPARATION

- A. Interior Surface Preparation: Remove all visible oil, wax, grease, soil, dirt and other soluble contaminants in accordance with SSPC-SP1 prior to blast cleaning. All surfaces shall be cleaned by near-white blast cleaning, removing all mill scale, rust, dirt, paint or foreign matter by recommended methods outlined in the Steel Structures Painting Council's Specification SSPC-SP10 and NACE No. 2 to establish a blast profile of 1.5 to 2.5 mils. Once the surface has been prepared, all weld seams shall be investigated. Any welds found to be deficient or that could result in structural failure, or any pits discovered because of surface preparation. Shall be rewelded (followed by grinding of repair to create a flush, consistent surface with the existing steel), pits shall be welded if greater than one half the thickness of the steel wall.
- B. Exterior Surface Preparation: The entire tank exterior shall be High Pressure washed 5000 psi minimum w/ a rotating tip. Injection* of surfactant (Simple Green 50/50 mix), to the entire tank surface, followed by a 100% clean water wash. All rusted areas shall be power washed (5K Rotating tip) no less than 6" from surface all loose paint chased until found to be sound. All rusted areas shall be cleaned to an SSPC-SP3 (no cup brushes allowed).
- C. All paint particles and used blast media containing paint particles shall be collected and removed from the tank site by the CONTRACTOR in accordance with federal, state and local requirements.
- D. Blasting shall not be performed when the surface temperature is less than 5°F above the dew point to prevent the formation of rust bloom.
- E. The compressed air used for blasting shall be free of water and oil.
- F. All dust, blasting debris and contaminants shall be removed from the surface prior to painting.
- G. Where practical, the CONTRACTOR shall complete all welding and other interior and exterior repairs authorized by the ENGINEER/OWNER, except for the caulking, prior to applying the primer.
- H. Interior or exterior welds, burning or repairs on or affecting previously blast-cleaned areas shall be re-blasted to duplicate the surrounding area.

3.4 APPLICATION

- A. Prepare surface and touch-up welds, burned and abraded areas with specified primer before applying full field coats.
- B. Mix, thin and apply each coating at the rate and manner specified by the manufacturer's current product data sheet.
- C. If tank surfaces are rolled, roller nap inclusions in the coating shall not be allowed. All roller nap and other foreign objects shall be removed (scraped, sanded, ground...) Followed by the application of another coat of finish, primer or both if required. Any and all touched up areas shall color match exactly to the surrounding coatings.
- D. All runs, drips, sags, curtains, etc. shall be brushed out during application or removed (scraped, sanded, ground...) Followed by the application of another coat of finish, primer or both if required. All touched up areas shall color match exactly to the surrounding coatings.
- E. Finish coats shall be uniform in color and sheen without streaks, laps, runs, sags or missed areas.
- F. Allow the interior coating to cure a minimum of 7 days before being subjected to immersion.
- G. Paints and coatings shall not transfer any substance to the water which will be toxic or cause tastes or odors (following curing).

3.5 THICKNESS AND SPREADING RATES

- A. Minimum dry mil thickness per coat (MDMTPC) and/or spreading rates in square feet per gallon shall be governed by the manufacturer's current data sheets or literature containing recommendations or instructions regarding these values. These recommended dry mil thickness and/or spreading rate values will be considered requirements to be met same as if set out herein these Specifications and Contract Documents and must be included with material list submittals before Consultant grants approval to use any paint materials. Do not exceed manufacturer's recommended coverage rates.
- B. The number of coats to be applied are specified herein and shall govern. Where the total dry film thickness is specified, this thickness shall govern over the MDMTPC

3.6 VENTILATION

- A. Ventilation is essential to remove vapors during application and curing of coatings.
- B. Ventilation shall be exhausted from lowest portion of tank with top openings kept clear.
- C. During coating applications the capacity of the ventilating fans shall be at least 400 cfm per gallon of coating applied per hour.
- D. The ventilation requirements are to ensure proper curing of the applied coatings and are not to be taken as requirements to ensure worker safety.
- E. Following the application of the final interior coating the tank shall be force ventilated by mechanical means from the lowest possible point for a minimum of 48 hours, ventilation shall be such that it creates a total turn-over on the interior of the tank a least once per hour.

3.7 INSPECTION

- A. Degree of surface cleanliness and blast profile of steel surfaces shall conform to the specifications detailed in Sections 3.02 and 3.03. Reference SSPC or NACE visual standards and consult Testex tape to verify anchor pattern.
- B. Wet film thickness readings for successive coats shall be taken as soon as possible at a frequency of at least one per 100 square feet.
- C. Dry film thickness readings of steel surfaces shall be taken prior to the application of successive coats with a nondestructive magnetic type gauge in accordance with SSPC-PA-2.
- D. All interior coated steel surfaces shall receive holiday testing with a Tinker Razor Model M-1, or equivalent, low voltage holiday detector. Any areas failing this test shall be marked and receive an additional repair coat in accordance with Section 3.03 - INTERIOR COATING SYSTEM until satisfactory test results are achieved.
- E. The final film is to be visually inspected and shall be free of sags, runs, wrinkles and other excessive film-build characteristics and surface defects.
- F. The CONTRACTOR shall maintain a contemporaneous daily inspection log to be used as a permanent record for the project and to compliment the periodic inspections by the OWNER'S representative. The contractor's inspection log shall include:
 - 1. Daily record of materials stored and used on-site.
 - 2. Ambient conditions: min. of three measurements daily of air and surface temperature, dew point, wind speed and direction, precipitation, etc.
 - 3. Production record: personnel on-site, hours worked, location of surface preparation and painted areas and materials used at each work area.
 - 4. In-process quality control observations as described in this section to include surface cleanliness, surface profile, wet film thickness, dry film thickness, visual defects, time between cleaning and priming and time between coats.
- G. The CONTRACTOR'S daily inspection log shall be made available at any time to the ENGINEER / OWNER or their representative and an updated copy shall be included with each pay request.

3.8 ACCEPTANCE OF WORK

- A. All surface preparation and repairs shall be approved by the OWNER before primer is applied. The CONTRACTOR shall request acceptance of each coat before applying next coat and shall correct work that is not acceptable and request re-inspection. All rigging to remain in place, and CONTRACTOR shall aid in use of rigging for all inspections by OWNER'S Representative.

3.9 REPAIRS

- A. Immediately after blast cleaning the tank interior surfaces, an inspection shall be made by the ENGINEER/OWNER or Representative in the presence of the CONTRACTOR to determine if any additional repair items will be authorized by the OWNER as additional work to be paid for at the Unit Bid prices for tank repair. This includes pit welding (sq. ft.), seam welding (lin. ft.) or patch welding (sq. ft.)
- B. All repairs shall be made in a manner to affect a permanent repair. Qualified personnel shall perform welding. Care shall be taken to avoid damage to seams, plates and pipe connections, which could result in leakage. The CONTRACTOR shall guarantee the water tank to be free from leakage upon completion of his work.
- C. Any welding on the tank shall be in conformance with requirements of AWWA Standard for welded steel tanks for water storage (AWWA D100-latest edition) Section 4.4 & Section 5.1 Bacteriological.
- D. Caulk interior roof lapped seams with Sika Flex-1A.
- E. Sharp edges can cause premature coating failure. All sharp edges, weld spatter and burrs should be ground flush.
- F. Fill sharp edged pits and pits deeper than 1/16" with Tnemec series 63-1500 Filler and Surfacer.

3.10 CLEANING AND DISINFECTION

- A. Cleaning: After painting, remove all scaffolding, planks, tools, rags, blast media and all other materials not part of the structural or operating facilities of the tank. Thoroughly clean and wash the walls, floor, roof and operating facilities of the tank by use of a high-pressure water jet, sweeping, scrubbing or other effective means. Flush out and otherwise remove from the tank all water, debris, and foreign materials accumulated during this cleaning operation. Thoroughly clean and flush out the bottom of the tank and the inlet/outlet pipe.
- B. Disinfecting: After cleaning, but before placing it in service, disinfect the inside of the tank in accordance with AWWA Standard C 652-latest edition, Section 4.3 by Chlorination Method 2.
- C. Sampling and Testing: After the chlorination is complete and before the tank is placed in service, water from the full facility shall be sampled and tested in accordance with AWWA Standard C652-latest edition, Section 4.4 & Section 5.1 Bacteriological.
- D. Chemicals and Equipment: Provide all necessary chlorine bearing compounds, solution tank, pumps, hoses, mops and other items required for cleaning, disinfection and flushing operations.
- E. Disposal of Heavily Chlorinated: Water from the disinfection process shall be in accordance with the KY EPPC Division of Water Requirements.
- F. Samples: Two or more successive sets of bacteriological samples, taken at 24-hour intervals, shall be taken and reported (using the most expedient method) to the Division of Water following disinfection.

3.11 CLEAN-UP

- A. Remove all debris and leave site in pre-project condition.

3.12 GUARANTEE

- A. The CONTRACTOR shall guarantee his work for a period of two years to the extent that he shall repair any defects due to faulty workmanship or materials that may appear on the structure during this period.
- B. A first anniversary inspection shall be conducted by the OWNER or Representative with the CONTRACTOR present in accordance with AWWA Standard D102-latest edition, Section 5.2.

END OF SECTION



DIVISION 40

PROCESS INTERCONNECTIONS



SECTION 40 05 00
PIPE AND PIPE FITTINGS - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Process piping systems.
 - 2. Utility piping systems.
 - 3. Plumbing piping systems.
- B. Work Included:
 - 1. Provide treated water distribution system as shown on the Drawings, specified herein, and needed for a complete and proper installation.
- C. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
 - 2. Section 40 05 51 - Valves - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M36, Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains (Equivalent ASTM A760).
 - b. M190, Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
 - c. M252, Standard Specification for Corrugated Polyethylene Drainage Tubing.
 - d. M294, Interim Specification for Corrugated Polyethylene Pipe 12 to 24 Inch Diameter.
 - 2. American Iron and Steel Institute (AISI).
 - 3. American Society of Mechanical Engineers (ASME):
 - a. B16.3, Malleable Iron Threaded Fittings.
 - b. B16.5, Pipe Flanges and Flanged Fittings.
 - c. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
 - d. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.
 - e. B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - f. B36.19, Stainless Steel Pipe.
 - g. B40.100, Pressure Gauges and Gauge Attachments.
 - 4. ASTM International (ASTM):
 - a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - b. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
 - c. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - d. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - e. A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - f. A197, Standard Specification for Cupola Malleable Iron.
 - g. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - h. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - i. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - j. A518, Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.

- k. A536, Standard Specification for Ductile Iron Castings.
 - l. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
 - m. A760, Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.
 - n. A774, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
 - o. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
 - p. B88, Standard Specification for Seamless Copper Water Tube.
 - q. C14, Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
 - r. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - s. C425, Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
 - t. C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 - u. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - v. C700, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.
 - w. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - x. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - y. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - z. D4101, Standard Specification for Polypropylene Plastic Injection and Extrusion Materials.
 - aa. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
 - bb. F441, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
5. American Water Works Association (AWWA):
 - a. B300, Standard for Hypochlorites.
 - b. C200, Standard for Steel Water Pipe - 6 IN and Larger.
 - c. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
 - d. C208, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
 - e. C606, Standard for Grooved and Shouldered Joints.
 - f. C651, Standard for Disinfecting Water Mains.
 - g. C800, Standard for Underground Service Line Valves and Fittings.
 6. American Water Works Association/American National Standards Institute (AWWA/ANSI):
 - a. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
 - b. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - c. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - d. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
 - e. C153/A21.53, Standard for Ductile-Iron Compact Fittings for Water Service.
 7. Chlorine Institute, Inc. (CI):
 - a. Pamphlet 6, Piping Systems for Dry Chlorine.
 8. Cast Iron Soil Pipe Institute (CISPI):
 - a. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 9. International Plumbing Code (IPC).

10. National Fire Protection Association (NFPA):
 - a. 54, National Fuel Gas Code.
 - b. 69, Standard on Explosion Prevention Systems.
11. Underwriters Laboratories, Inc. (UL).

B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

1.3 DEFINITIONS

- A. Hazardous Gas Systems: Digester gas, chlorine gas, sulfur dioxide gas, carbon dioxide gas, lab gases.
- B. HPIC: High performance industrial coating.
- C. PVDF: Polyvinylidene fluoride.

1.4 SYSTEM DESCRIPTION

- A. Piping Systems Organization and Definition:
 1. Piping services are grouped into designated systems according to the chemical and physical properties of the fluid conveyed, system pressure, piping size and system materials of construction.
 2. See PIPING SYSTEMS SCHEDULE in PART 3.

1.5 SUBMITTALS

- A. Submit six copies of product data sheets on material to be used.
- B. Shop Drawings:
 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
 - c. Separate schedule sheet for each piping system scheduled in this Specification Section showing compliance of all system components.
 - 1) Attach technical product data on gaskets, pipe, fittings, and other components.
 2. Fabrication and/or Layout Drawings:
 - a. Exterior yard piping drawings (minimum scale 1 IN equals 10 FT) with information including:
 - 1) Dimensions of piping lengths.
 - 2) Invert or centerline elevations of piping crossings.
 - 3) Acknowledgement of bury depth requirements.
 - 4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.
 - 5) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe and line numbers.
 - 6) Line slopes and vents.
 3. Names and addresses of the nearest service and maintenance organization that readily stocks repair parts.
 4. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the Work.
- C. Informational Submittals:
 1. Qualifications of lab performing disinfection analysis on water systems.
 2. Test reports:
 - a. Copies of pressure test results on all piping systems.
 - b. Reports defining results of dielectric testing and corrective action taken.
 - c. Disinfection test report.
 - d. Notification of time and date of piping pressure tests.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect pipe coating during handling using methods recommended by manufacturer.
 - 1. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.
- B. Prevent damage to pipe during transit.
 - 1. Repair abrasions, scars, and blemishes.
 - 2. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Insulating unions:
 - a. "Dielectric" by Epco.
 - 2. Dirt strainers (Y type):
 - a. Mueller (#351).
 - b. Sarco.
 - c. Armstrong.
 - 3. Chemical strainers (Y type):
 - a. Chemtrol.
 - b. Asahi.
 - 4. Dry disconnect couplings:
 - a. Kamlock.
 - 5. Dielectric flange kit:
 - a. PSI.
 - b. Maloney.
 - c. Central Plastics.
 - 6. Pipe saddles (for gage installation):
 - a. Dresser Style 91 (steel and ductile iron systems).
 - b. Dresser Style 194 (nonmetallic systems).
 - 7. Expansion joint at FRP and poly tanks:
 - a. PROCO.
 - b. Garlock, Style 215.
 - 8. Elastomeric bellows type expansion joints:
 - a. Garlock, Guardian 200/204.
 - b. PROCO, equivalent model.
 - c. Red Valve, equivalent model.
 - d. Or equal.
 - 9. Dismantling Joint
 - a. Romac DJ400.
 - b. Smith Blair 972.

2.2 PIPING SYSTEMS SCHEDULE

- A. Piping system materials, fittings and appurtenances are subject to requirements of specific piping systems schedule located at the end of PART 3 of this Specification Section.

2.3 COMPONENTS AND ACCESSORIES

- A. General – Provide pipe, fittings, and accessories complying with the following requirements:
- B. Pipe
 - 1. DIP (Ductile Iron Pipe)
 - a. Ductile iron push on joint
 - 1) Comply with ANSI A-21.11 (AWWA C111).

- b. Ductile iron flanged joint
 - 1) Comply with either ANSI A-21.15 (AWWA C115) with a 125 pound flanged joint or ANSI B-16.1 - ANSI B16.5 with a 125 pound cast iron "Uni-Flange" adapter as manufactured by Uni-Flange Corporation.
 - 2. PVC (Polyvinyl Chloride) Pipe
 - a. Use rigid unplasticized polyvinyl chloride (PVC) complying with ASTM D1784 and D2241. The PVC compound used in the manufacture of this pipe shall meet or exceed the requirements for class 12454-A or 12454-B as defined by ASTM D1784. Provide pipe with a standard dimension ratio (SDR) of 21 with pressure rating of 200 psi complying with ASTM D2241. Provide an NSF approved pipe for potable water service.
 - b. In addition, Pipe shall be tested and inspected at the factory. Testing shall be accomplished in conformance with the following ASTM specifications utilizing the test methods specified therein:
 - 1) Dimensions ASTM D 3034-81 or ASTM F679-80 and D 2122-81
 - 2) Extrusion Quality ASTM D 2152-80
 - 3) Pipe Stiffness (5%) ASTM D 2412-77
 - 4) Impact Resistance ASTM D 2444-80
 - 3. HDPE (High Density Polyethylene) Pipe – Use HDPE with a standard dimension ratio (DR) of 11 with a working pressure rating of 160 psi and conforming to ASTM F714 and D3035. The pipe shall be sized with standard iron pipe size (IPS) and shall be DriscoPlex 4100 or approved equal.
 - 4. Restrained-Joint PVC Pipe – Use Certa-Lok C900/RJ PVC pipe with a working pressure rating of 200 psi (DR 14) as manufactured by Certain Teed Pipe and Plastics Group or approved equal.
- C. Joints
 - 1. DI (Ductile Iron) Push-On-Joint – Comply with ANSI A-21.11 (AWWA C111)
 - 2. DI (Ductile Iron) Flanged Joint – Comply with either ANSI A-21.15 (AWWA C115) with a 125-lb flanged joint or ANSI B-16.1 - ANSI B16.5 with a 125-lb cast iron "Uni-Flange" adapter as manufactured by Uni-Flange Corporation.
 - 3. PVC (Polyvinyl-Chloride) Joint
 - a. Provide a push on type joint with a continuous elastomeric ring gasket compressed into the annular space between bell and spigot end of pipe complying with ASTM D3139.
 - b. A typical joint assembly shall be tested by a qualified independent laboratory per test requirements of ASTM D3212-81. The manufacturer shall submit to the Engineer sufficient copies of certification and test results by shipment to the job site that will permit the Owner to retain two copies.
 - 4. HDPE (High Density Polyethylene) Joint – Form joints by heat fusion method in accordance with the manufacturer's recommendations and ASTM D3261.
- D. Fittings
 - 1. Use mechanical joint fittings for all exterior below grade pressure piping complying with AWWA C153.
 - 2. Use cement lining complying with ANSI A-21.4 (AWWA C104) with a bituminous seal coat.
 - 3. All fittings must be manufactured in the United States of America unless otherwise approved by the Engineer.
 - 4. Double wrap all fittings with 8-mil polyethylene wrap prior to placing concrete thrust blocking. Tape polyethylene wrapping around pipe barrels to provide a water tight seal around the fittings
 - 5. HDPE Fittings – Use HDPE fittings conforming to AWWA C906 requirements. Provide mechanical joint adapter kits at transition points to other pipe types.
- E. Valves
 - 1. Gate Valves
 - a. Provide gate valves in accordance with Section 40 05 00 of these specifications.

- b. Provide connections as required for the piping in which they are installed.
- c. Provide all exterior below grade valves with standard operating nut and all interior valve with handwheel. Provide tee handle socket operating wrenches of suitable size.
- d. Provide below grade valves with valve boxes of the screw type adjustable pattern with a lid marked water.
- e. Valves 3" and smaller
 - 1) Provide all bronze, screwed, single wedge disc, screw in bonnet, packing gland, and nut, with a non-rising stem.
 - 2) Provide below grade valves with a suitable precast concrete box with a lid marked water.
- 2. Butterfly Valves
 - a. With the exception of tapping valves, all valves 16" and larger shall be butterfly valves unless otherwise noted on the drawings.
 - b. Provide butterfly valves in accordance with Section 40 05 00 of these specifications.
- 3. Tapping Valves – Use tapping valves meeting the general operating and material requirements of Section E.1. of this specification. Use Mueller RWGV tapping valve, or approved equal.
- 4. Valve Boxes
 - a. For butterfly valves, use cast iron, slip type adjustable pattern, similar and equal to Bingham & Taylor or Utility Pipe Model CVB562. For gate valves, use cast iron screw type adjustable pattern, similar and equal to Bingham & Taylor 4905.
 - b. The boxes shall have a lid marked "water" similar and equal to Bingham & Taylor 4905-L1.5.
 - c. The valve boxes shall be of sufficient length to permit the valve to set at the depth indicated by required cover on the pipe shown on the Drawings. Provide cast iron valve box extensions, as necessary, similar or equal to Bingham & Taylor 4905-X.
 - d. Provide valve stem extensions on all water lines greater than 6 feet deep. Valve stem extensions shall be similar or equal to Bingham & Taylor 5051.
- F. Restraint Joint Gaskets – Use restrained joint gaskets in all DIP installation within steel encasement. In addition, use restrained joint gaskets in all pipe joints within creek crossings and roadway crossings and within one DIP pipe joint connection either side of steel encasement. Use "Field Lok" gaskets as manufactured by U.S. Pipe and Foundry Company.
- G. Thrust Restraint Glands for Ductile Iron Pipe – Use thrust restraint glands ensuring 360° contact between the gland and the pipe wall. Uni-Flange Series 1300 joint restraint devices as manufactured by Ford Meter Box Company, Inc. or approved other. Use thrust restraint glands on each mechanical joint connection 6" in diameter and larger.
- H. Thrust Restraint Glands for PVC Pipe – Use thrust restraint glands ensuring 360° contacts between the gland and the pipe wall. Use Uni-flange Series 1300 joint restraint devices as manufactured by Ford Meter Box Company, Inc. or approved other. Use thrust restraint glands for PVC pipe on each mechanical joint connection 6" in diameter and larger.
 - 1. SO-EZ MJ Gland Snap-On Gaskets, as manufactured by Ford Meter Box Company, Inc. shall not be accepted for use on any mechanical joint piping or restraint
- I. Joint Restraint Glands for PVC Pipe – Use joint restraint glands ensuring 360° contact between the gland and the pipe wall. Use Uni-Flange Series 1390 joint restraint devices as manufactured by Ford Meter Box Company, Inc., or approved other. Use joint restraint glands at field engineer's discretion or as shown on the Plans.
- J. Petroleum -Resistant Gaskets – Where noted on the drawings, provide petroleum-resistant gaskets for push-on and mechanical joint fittings. Petroleum-resistant gaskets shall be manufactured from Nitrile in accordance with AWWA C111.
- K. Stainless Steel All-thread Rods – Use 3/4" diameter stainless steel all-thread rods complying with ASTM Type 303 stainless steel. Use rods at field engineer's discretion or as shown on the Plans. Cost associated with contractor installation, equipment, materials, etc., is incidental to the cost for pipe.

- L. Service Saddles – Use service saddles as manufactured by Ford Meter Box Company with all service connections made on PVC or asbestos cement pipe.
- M. Tapping Sleeves – Use stainless steel tapping sleeves as manufactured by Romac Industries, Inc., Seattle, Washington, or approved equal.
- N. Steel Casing Pipe – Use steel casing pipe conforming to ASTM A139. All encasement shall have a minimum yield strength of 35,000 psi and a minimum thickness of .25 inches for casing diameter of 16 inches and less, 0.312 inch thickness for casing diameters of 18, 20, and 22 inches, and 0.344 inch thickness for casing diameter of 24 inches. Coat the outside of all steel encasement pipe with either an epoxy or bituminous coating. Casing spacers and end seals are considered incidental to the unit price of the steel encasement.
- O. Fire Hydrants
 - 1. General
 - a. Use fire hydrants complying in all respects with the latest revision for AWWA C502. use fire hydrants with one (1) 4½” pumper nozzle with National Standard Thread and two (2) 2½” bronze hose nozzles with National Standard Thread. Secure all caps with long heavy chains. Use hydrants with a one piece bronze operating nut to be opened in a counterclockwise direction. Use hydrants with a compression main valve, bronze seat ring with bronze seating. Bronze upper plate, high tensile steel stem, and O-ring seals. The inlet valve opening shall be 5¼” diameter with 6½” ID standpipe section and a 6” high strength cast iron inlet connection.
 - b. Use hydrants with replaceable, breakable sections, or components such that in the event the barrel is broken off, the valve will remain closed, the barrel will not be damaged, and the stem will not be bent.
 - c. Furnish hydrants from the factory with one shop coat of bright red Inertol Rust Inhibitive Primer No. 621 with a minimum dry mil thickness of 1.5.
 - d. Use Mueller Super Centurion 250, Kennedy, or approved other.
 - 2. Hydrant Valves – Equip all 5¼” hydrants with 6” gate valves as shown on the drawings.
 - 3. Anchoring Tee – Use standard mechanical joint anchoring tees with a split ductile iron rotating gland on the branch. Use trim tyte ductile iron mechanical joint anchoring tees as manufactured by U.S. Pipe and Foundry Company, Birmingham, Alabama, or an approved equal.
 - 4. Hydrant Connecting Pieces – Use hydrant connecting pieces with integrally cast standard mechanical joint on one end and a split ductile iron rotating gland on the other. Use hydrant connecting pieces as manufactured by American Cast Iron Pipe Company, Birmingham, Alabama, No. A108954 or an approved equal.
- P. Copper Pipe
 - 1. Pipe – Use Type "K" soft copper tubing complying with ASTM Specifications B 88 and AWWA Specification C800. Install service lines with a continuous run of pipe from the main to the meter.
 - 2. Fittings – All fittings or unions for the copper service lines shall be of standard brass compression stop type for flared connections. Threads on fittings shall conform to AWWA C800, "Standard Threads for Underground Service Line Fittings."
 - 3. Verification – Verify the size of existing service lines prior to installation of replacement or relocated service lines. Notify the Engineer prior to installation of any discrepancies between plan information and field verified information.
- Q. Polyethylene Pipe
 - 1. Pipe – Use copper tubing size P.E. Municipal Service tubing complying with ASTM Specifications ASTM D2737. Install service lines with a continuous run of pipe from the main to the meter. All PE service lines shall be installed with a continuous run of tracer wire.
 - 2. Fittings – All fittings or unions for the P.E. service lines shall be of standard brass type for pack joint connections. Threads on fittings shall conform to AWWA C800, "Standard Threads for Underground Service Line Fittings."

3. Verification – Verify the size of existing service lines prior to installation of replacement or relocated service lines. Notify the Engineer prior to installation of any discrepancies between plan information and field verified information.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 FIELD MEASUREMENTS

- A. Make necessary measurements in the field to assure precise fit of items in accordance with the approved design.

3.3 HANDLING

- A. Handle pipe accessories so as to ensure delivery to the trench in sound, undamaged condition:
 1. Carry pipe into position; do not drag.
 2. Use pinch bars or tongs for aligning or turning the pipe only on the bare end of the pipe.
- B. Thoroughly clean interior of pipe and accessories before lowering pipe into trench. Keep clean during laying operations by plugging or other method approved by the Engineer.
- C. Before installation, inspect each piece of pipe and each fitting for defects: Material found to be defective before or after laying: Replace with sound material meeting the specified requirements, and without additional cost to the Owner.
- D. Store rubber gaskets in a cool dark place until just prior to time of installation.

3.4 EXTERIOR BURIED PIPING INSTALLATION

- A. Unless otherwise shown on the Drawings, provide a minimum of [4] FT and maximum of [8] FT earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing.
- B. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals specified in Specification Section 01 73 20 and as shown on Drawings.
- C. When entering or leaving structures with buried [mechanical] joint piping, install joint within 2 FT of point where pipe enters or leaves structure.
 1. Install second joint not more than 6 FT nor less than 4 FT from first joint.
- D. Install expansion devices as necessary to allow expansion and contraction movement.
- E. Laying Pipe In Trench:
 1. Excavate and backfill trench in accordance with Specification Section 31 23 33.
 2. Clean each pipe length thoroughly and inspect for compliance to specifications.
 3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
 4. Install gasket or joint material according to manufacturer's directions after joints have been thoroughly cleaned and examined.
 5. Except for first two joints, before making final connections of joints, install two full sections of pipe with earth tamped alongside of pipe or final with bedding material placed.
 6. Lay pipe in only suitable weather with good trench conditions.
 - a. Never lay pipe in water except where approved by Engineer.
 7. Seal open end of line with watertight plug if pipe laying stopped.
 8. Remove water in trench before removal of plug.
- F. Lining Up Push-On Joint Piping:
 1. Lay piping on route lines shown on Drawings.
 2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.

3. Observe maximum deflection values stated in manufacturer's written literature.
 4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.
 5. Install shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.
- G. Anchorage and Blocking:
1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for preventing movement of piping caused by forces in or on buried piping tees, wye branches, plugs, or bends.
 2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall.
 - a. Concrete blocks shall not cover pipe joints.
 3. Provide bearing area of concrete in accordance with drawing detail.
- H. Install underground hazard warning tape per Specification Section 10 14 00.
- I. Install insulating components where dissimilar metals are joined together.

3.5 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION

- A. Install piping in vertical and horizontal alignment as shown on Drawings.
- B. Alignment of piping smaller than 4 IN may not be shown; however, install according to Drawing intent and with clearance and allowance for:
1. Expansion and contraction.
 2. Operation and access to equipment, doors, windows, hoists, moving equipment.
 3. Headroom and walking space for working areas and aisles.
 4. System drainage and air removal.
- C. Enter and exit through structure walls, floor and ceilings using penetrations and seals specified in Specification Section 01 73 20 and as shown on the Drawings.
- D. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.
- E. Pipe Support:
1. Use methods of piping support as shown on Drawings and as required in Specification Section 40 05 07.
 2. Where pipes run parallel and at same elevation or grade, they may be grouped and supported from common trapeze-type hanger, provided hanger rods are increased in size as specified for total supported weight.
 - a. The pipe in the group requiring the least maximum distance between supports shall set the distance between trapeze hangers.
 3. Size pipe supports with consideration to specific gravity of liquid being piped.
- F. Locate and size sleeves and castings required for piping system.
1. Arrange for chases, recesses, inserts or anchors at proper elevation and location.
- G. Use reducing fittings throughout piping systems.
1. Bushings will not be allowed unless specifically approved.
- H. Equipment Drainage and Miscellaneous Piping:
1. Provide drip pans and piping at equipment where condensation may occur.
 2. Hard pipe stuffing box leakage to nearest floor drain.
 3. Avoid piping over electrical components such as motor control centers, panelboards, etc.
 - a. If piping must be so routed, utilize 16 GA, 316 stainless steel drip pan under piping and over full length of electrical equipment.
 - b. Hard pipe drainage to nearest floor drain.
 4. Collect system condensate at drip pockets, traps and blowoff valves.
 5. Provide drainage for process piping at locations shown on Drawings in accordance with Drawing details.
 6. For applications defined above and for other miscellaneous piping which is not addressed by a specific piping service category in PART 1, provide 304 stainless steel piping and fittings.

- a. Size to handle application with 3/4 IN being minimum size provided.
- I. Unions:
 - 1. Install in position which will permit valve or equipment to be removed without dismantling adjacent piping.
 - 2. Mechanical type couplings may serve as unions.
 - 3. Additional flange unions are not required at flanged connections.
- J. Install expansion devices as necessary to allow expansion/contraction movement.
- K. Provide full face gaskets on all systems.
- L. Anchorage and Blocking:
 - 1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to prevent separation of joints and transmission of stress into equipment or structural components not designed to resist those stresses.
- M. Equipment Pipe Connections:
 - 1. Equipment - General:
 - a. Exercise care in bolting flanged joints so that there is no restraint on the opposite end of pipe or fitting which would prevent uniform gasket pressure at connection or would cause unnecessary stresses to be transmitted to equipment flanges.
 - b. Where push-on joints are used in conjunction with flanged joints, final positioning of push-on joints shall not be made until flange joints have been tightened without strain.
 - c. Tighten flange bolts at uniform rate which will result in uniform gasket compression over entire area of joint.
 - 1) Provide tightening torque in accordance with manufacturer's recommendations.
 - d. Support and match flange faces to uniform contact over their entire face area prior to installation of any bolt between the piping flange and equipment connecting flange.
 - e. Permit piping connected to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
 - f. Align, level, and wedge equipment into place during fitting and alignment of connecting piping.
 - g. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
 - h. To provide maximum flexibility and ease of alignment, assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened.
 - 1) Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
 - 2) Realign as necessary, install flange bolts and make equipment connection.
 - i. Provide utility connections to equipment shown on Drawings, scheduled or specified.
 - 2. Plumbing and HVAC equipment:
 - a. Make piping connections to plumbing and HVAC equipment, including but not limited to installation of fittings, strainers, pressure reducing valves, flow control valves and relief valves provided with or as integral part of equipment.
 - b. Furnish and install sinks, fittings, strainers, pressure reducing valves, flow control valves, pressure relief valves, and shock absorbers which are not specified to be provided with or as integral part of equipment.
 - c. For each water supply piping connection to equipment, furnish and install union and gate or angle valve.
 - 1) Provide wheel handle stop valve at each laboratory sink water supply.
 - 2) Minimum size: 1/2 IN.
 - d. Furnish and install "P" trap for each waste piping connection to equipment if waste is connected directly to building sewer system.
 - 1) Size trap as required by IPC.
 - e. Stub piping for equipment, sinks, lavatories, supply and drain fittings, key stops, "P" traps, miscellaneous traps and miscellaneous brass through wall or floor and cap and protect until such time when later installation is performed.

- N. Provide insulating components where dissimilar metals are joined together.
- O. Instrument Connections:
 - 1. See drawing details.

3.6 CONNECTIONS WITH EXISTING PIPING

- A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.
- B. Perform connections with existing piping at time and under conditions which will least interfere with service to customers affected by such operation.
- C. Undertake connections in fashion which will disturb system as little as possible.
- D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.
- E. Where connections to existing systems necessitate employment of past installation methods not currently part of trade practice, utilize necessary special piping components.
- F. Where connection involves potable water systems, provide disinfection methods as prescribed in this Specification Section.
- G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

3.7 ACCESS PROVISIONS

- A. Provide access doors or panels in walls, floors, and ceilings to permit access to valves, piping and piping appurtenances requiring service.
- B. Size of access panels to allow inspection and removal of items served, minimum 10 x 14 IN size.
- C. Fabricate door and frame of minimum 14 GA, stretcher leveled stock, cadmium plated or galvanized after fabrication and fitted with screw driver lock of cam type.
- D. Provide with key locks, keyed alike, in public use areas.
- E. Furnish panels with prime coat of HPIC. See Specification Section 09 96 00.
- F. Style and type as required for material in which door installed.
- G. Where door is installed in fire-rated construction, provide door bearing UL label required for condition.

3.8 FIELD QUALITY CONTROL

- A. Pipe Testing - General:
 - 1. The Contractor shall furnish all materials, equipment, tools and labor necessary to perform all of the tests called for and required herein. The hydrostatic tests shall consist of a pressure test and leakage test. The Contractor may backfill the pipe at his discretion; however, if the pipe has to be repaired it shall be uncovered, repaired and backfilled at no expense to the Owner
 - 2. Test piping systems as follows:
 - a. Test exposed, non-insulated piping systems upon completion of system.
 - b. Test exposed, insulated piping systems upon completion of system but prior to application of insulation.
 - c. Test concealed interior piping systems prior to concealment and, if system is insulated, prior to application of insulation.
 - d. Test buried piping (insulated and non-insulated) prior to backfilling and, if insulated, prior to application of insulation.
 - 3. Isolate equipment which may be damaged by the specified pressure test conditions.
 - 4. Perform pressure test using calibrated pressure gages and calibrated volumetric measuring equipment to determine leakage rates.

- a. Select each gage so that the specified test pressure falls within the upper half of the gage's range.
- b. Notify the Engineer 24 HRS prior to each test.
- 5. Completely assemble and test new piping systems prior to connection to existing pipe systems.
- 6. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance.
- 7. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.

B. Pressure Testing:

- 1. Testing medium: Unless otherwise specified in the PIPING SYSTEMS SCHEDULE, utilize the following test media.
 - a. Process systems:

PIPE LINE SIZE	SPECIFIED TEST PRESSURE	TESTING MEDIUM
2 IN and smaller	75 PSI or less	Water
2 IN and smaller	Greater than 75 PSI	Water
Greater than 2 IN	3 PSI or less	Water
Greater than 2 IN	Greater than 3 PSI	Water

- b. Laboratory gases and natural gas systems: Cylinder nitrogen.
- c. Liquid systems:

PIPE LINE SIZE (DIA)	GRAVITY OR PUMPED	SPECIFIED TEST PRESSURE	TESTING MEDIUM
Up to and including 48 IN	Gravity	25 PSIG or less	Water
Above 48 IN	Gravity	25 PSIG or less	Water
All sizes	Pumped	250 PSIG or less	Water

- 2. Allowable leakage rates:
 - a. Hazardous gas systems, all exposed piping systems, all pressure piping systems and all buried, insulated piping systems which are hydrostatically pressure tested shall have zero leakage goal at the specified test pressure throughout the duration of the test.
 - b. Hydrostatic exfiltration and infiltration for sanitary and stormwater sewers (groundwater level is below the top of pipe):
 - 1) Leakage rate: 200 GAL per inch diameter per mile of pipe per day at average head on test section of 3 FT.
 - 2) Average head is defined from groundwater elevation to average pipe crown.
 - 3) Acceptable test head leakage rate for heads greater than 3 FT: Acceptable leakage rate (gallons per inch diameter per mile per day) equals 115 by (actual test head to the 1/2 power).
 - c. Hydrostatic infiltration test for sanitary and stormwater sewers (groundwater level is above the top of pipe):
 - 1) Allowable leakage rate: 200 GAL per inch diameter per mile of pipe per day when depth of groundwater over top of pipe is 2 to 6 FT.
 - 2) Leakage rate at heads greater than 6 FT: Allowable leakage rate (gallons per inch diameter per mile of pipe per day) equals 82 by (actual head to the 1/2 power).
 - d. Large diameter (above 48 IN) gravity plant piping systems shall have a maximum exfiltration of 25 GPD per inch-mile.
 - e. Non-hazardous gas and air systems which are tested with air shall have a maximum pressure drop of 5% of the specified test pressure throughout the duration of the test.

- f. For low pressure (less than 25 PSIG) air testing, the acceptable time for loss of 1 PSIG of air pressure shall be:

PIPE SIZE (IN DIA)	TIME, MINUTES/100 FT
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0
42	7.3
48	7.6

3. Hydrostatic pressure testing methodology:
- a. General:
 - 1) All joints, including welds, are to be left exposed for examination during the test.
 - 2) Provide additional temporary supports for piping systems designed for vapor or gas to support the weight of the test water.
 - 3) Provide temporary restraints for expansion joints for additional pressure load under test.
 - 4) Isolate equipment in piping system with rated pressure lower than pipe test pressure.
 - 5) Do not coat or insulate exposed piping until successful performance of pressure test.
 - b. Soil, waste, drain and vent systems:
 - 1) Test at completion of installation of each stack or section of piping by filling system with water and checking joints and fittings for leaks.
 - 2) Eliminate leaks before proceeding with work or concealing piping.
 - 3) Minimum test heights shall be 10 FT above highest stack inlet.
 - c. Larger diameter (above 36 IN) gravity plant piping:
 - 1) Plug downstream end of segment to be tested.
 - a) Provide bracing as required.
 - 2) Fill segment and upstream structure to normal operating level as per hydraulic profile.
 - 3) Allow 24 HRS for absorption losses.
 - a) Refill to original level.
 - 4) Provide reservoir to maintain constant head over duration of test.
 - 5) Record reservoir water volume at beginning and end of test.

3.9 CLEANING, DISINFECTION AND PURGING

A. Cleaning:

1. Clean interior of piping systems thoroughly before installing.
 2. Maintain pipe in clean condition during installation.
 3. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
 - a. Pig high pressure air piping before connecting to valves or instruments.
 4. At completion of work and prior to Final Acceptance, thoroughly clean work installed under these Specifications.
 - a. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge which may have accumulated by operation of system, from testing, or from other causes.
 - b. Repair any stoppage or discoloration or other damage to parts of building, its finish, or furnishings, due to failure to properly clean piping system, without cost to Owner.
 5. All completed water mains, valves, tees, crosses, etc., shall be disinfected in accordance with "AWWA Standard for Disinfecting Water Mains ANSI/AWWA C651-99" and in accordance with the following requirements:
 - a. The mains shall be thoroughly disinfected before being placed in service by the use of chlorine or chlorine compounds in such amount as to produce a concentration of at least 50 PPM and a residual of at least 25 PPM at the end of 24 hours.
 - b. The chlorine residual at the end of the 24 hour period will be verified by the Contractor in the presence of the Engineer and a representative of the County Health Department. If the chlorine residual in the main is less than 25 ppm, the main shall be disinfected again.
 - c. After the chlorine residual has been verified, the main shall be thoroughly flushed until the chlorine concentration is found to be at levels equal to levels within the surrounding water system. A water sample shall be taken at that time for a bacteria test to be performed by a state certified laboratory. The Contractor will be responsible for sampling and testing at his own expense.
 - d. All water used in disinfection shall be dechlorinated and approved by the Engineer prior to discharge to surface water or surrounding area
 6. Purge all neat liquid polymer tubing or piping between the neat polymer storage tank or tote and the polymer blending units with mineral oil to remove residual water prior to introducing neat polymer. Following purging, drain as much of the mineral oil out of the system as possible. Dispose of purged fluids and waste mineral oil in accordance with local environmental regulations.
- B. Disinfection of Potable Water Systems:
1. After favorable performance of pressure test and prior to Final Acceptance, thoroughly flush entire potable water piping system including supply, source and any appurtenant devices and perform disinfection as prescribed.
 2. Perform work, including preventative measures during construction, in full compliance with AWWA C651.
 3. Perform disinfection using sodium hypochlorite complying with AWWA B300.
 4. Flush each segment of system to provide flushing velocity of not less than 2.5 FT per second.
 5. Drain flushing water to sanitary sewer.
 - a. Do not drain flushing water to receiving stream.
 6. Use continuous feed method of application.
 - a. Tag system during disinfection procedure to prevent use.
 7. After required contact period, flush system to remove traces of heavily chlorinated water.
 8. After final flushing and before placing water in service, obtain an independent laboratory approved by the Owner to collect samples and test for bacteriological quality.
 - a. Repeat entire disinfection procedures until satisfactory results are obtained.
 9. Secure and deliver to Owner, satisfactory bacteriological reports on samples taken from system.
 - a. Ensure sampling and testing procedures are in full compliance to AWWA C651, local water purveyor and applicable requirements of State of Kentucky.

3.10 LOCATION OF BURIED OBSTACLES

- A. Furnish exact location and description of buried utilities encountered and thrust block placement.
- B. Reference items to definitive reference point locations such as found property corners, entrances to buildings, existing structure lines, fire hydrants and related fixed structures.
- C. Include such information as location, elevation, coverage, supports and additional pertinent information.
- D. Incorporate information on "As-Recorded" Drawings.

3.11 PIPE INSULATION

- A. Insulate pipe and pipe fittings in accordance with contract documents.

3.12 PIPING SYSTEM SCHEDULES

- A. Piping System 10 – Buried and Exposed Potable Water Piping.
 - 1. General:
 - a. Test requirements:
 - 1) Test medium: Water.
 - 2) Pressure: 1.25 x working pressure.
 - 3) Duration: 6 HRS.
 - b. Gaskets and O-rings:
 - 1) O-rings: Neoprene or rubber.
 - 2) Flanged, push-on and mechanical joints (ductile iron): Rubber, AWWA/ANSI C111/A21.11.
 - 3) Flanged joints (steel): Rubber, AWWA C207.
 - 4) Grooved coupling joints (ductile and steel): Rubber, AWWA C606.
 - 2. System components:
 - a. Pipe size to 3 IN:
 - 1) Exposed service:
 - a) Material: Copper tubing, Type L.
 - b) Solder: Cadmium and lead-free solder compatible with tubing and fittings materials.
 - c) Reference: ASTM B88.
 - d) Lining: None.
 - e) Coating: HPIC; See Specification Section 09 96 00.
 - f) Fittings: Wrought copper or bronze fittings meeting ASME B16.22.
 - g) Joints: Soldered or brazed with unions at valves and equipment.
 - 2) Buried service:
 - a) Material: Copper tubing, Type K.
 - b) Reference: ASTM B88.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: AWWA C800.
 - f) Joints: Flared.
 - b. Pipe size 3 IN through 24 IN:
 - 1) Exposed service:
 - a) Materials:
 - (1) Flanged: Ductile iron
 - (2) Grooved type joint system: Use pipe thickness per AWWA C606.
 - (3) With both systems, provide screwed on flanges at equipment, valves and structural penetrations.
 - b) Reference: AWWA/ANSI C115/A21.15.
 - c) Lining: Cement.
 - d) Coating: HPIC; See Specification Section 09 96 00.
 - e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.

- f) Joints:
 - (1) Flanged or grooved type mechanical coupling (AWWA C606) joints.
 - (2) With both systems, provide screwed-on flanges at valves, equipment, and structure penetration.
- 2) Buried service:
 - a) Materials: Ductile iron, Class
 - b) Reference: AWWA/ANSI C151/A21.51.
 - c) Lining: Cement.
 - d) Coating: Bituminous.
 - e) Fittings:
 - (1) Either AWWA/ANSI C110/A21.10 ductile or gray iron.
 - (2) Optional: AWWA/ANSI C153/A21.53 ductile iron compact fittings for sizes 3 to 16 IN.
 - f) Joints: Push-on with mechanical (stuffing box type) joints at fittings and valves.
- c. Pipe size greater than 24 IN:
 - 1) Exposed service:
 - a) Material: Steel, fabricated pipe.
 - b) Reference: AWWA C200.
 - c) Lining: Cement.
 - d) Coating: HPIC; See Specification Section 09 96 00.
 - e) Fittings: AWWA C208.
 - f) Joints: Butt welded with rigid AWWA C207 flanges at equipment, valves, and structure penetrations.
 - 2) Buried service:
 - a) Material: Steel, fabricated pipe.
 - b) Reference: AWWA C200.
 - c) Lining: Cement.
 - d) Coating: Bituminous.
 - e) Fittings: AWWA C208.
 - f) Joints: Butt welded.
- 3. Install drain tees with capped nipples of IPS brass 3 IN long at low points.
 - a. If low point occurs in concealed piping, provide approved flush access panel.
 - b. These drains are not shown on Drawings.
- 4. Slope water lines down to drain points not less than 1 IN in 60 FT.
- 5. Install all threaded piping with clean-cut tapered threads and with ends thoroughly reamed after cutting to remove burrs.
 - a. Pipe joint cement permitted only on external threads.
- 6. For screwed nipples for connections to flush valves, lavatory supplies, and other equipment with threaded connections use iron, copper, or brass pipe.
- 7. Install ball, butterfly and plug valves where indicated or required to adequately service all parts of system and equipment.
 - a. Install valves on each branch serving restroom.
 - b. Install valves on inlet and outlet connections of heat exchangers and on other equipment connected to water lines.
- 8. Install unions between valves and connections to each piece of equipment and install sufficient number of unions throughout piping system to facilitate installation and servicing.
 - a. On copper pipelines, install wrought, solder-joint, copper to copper unions for lines 2 IN and smaller and, for lines 2-1/2 IN and over install brass flange unions.
- 9. Construct and equip plumbing fixtures and equipment with anti-siphon devices as to entirely eliminate any danger of siphoning waste material into potable water supply system.
- 10. Where exposed pipes 6 IN in size and smaller pass through floors, finished walls, or finished ceilings, fit with nickel or chrome-plated plates large enough to completely close hole around pipes.
 - a. Secure plates to pipe by set screw in approved manner.
- 11. Size supply branches to individual fixtures as scheduled or indicated on Drawings.

12. Install piping so as to be free to expand with proper loops, anchors and joints without injury to system or structure.
13. Provide branches to wall hydrants or hose bibbs in exterior locations with interior shutoff and drain valves.
14. Provide approved type vacuum breaker and backflow preventer installations indicated or as required by Code.
15. Install concealed in finished structures such as administration and office facilities and at locations shown on Drawings. The following Table B is a summary of the piping services currently available. It is anticipated that most projects would include piping symbols on the drawings, so leave the table as optional text, unless the piping symbology is not listed on the drawings. If this table is used, make the table normal text and modify it based on client and project requirements.

3.13 SERVICE SYSTEM SUMMARY

- A. Service Systems as defined in the Drawings.

END OF SECTION

SECTION 40 05 51
VALVES - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Valving, actuators, and valving appurtenances.
- B. Related Sections include but are not necessarily limited to:
 - 1. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B1.20.1, Pipe Threads, General Purpose.
 - b. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - c. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASTM International (ASTM):
 - a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - b. D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
 - c. D638, Standard Test Method for Tensile Properties of Plastics.
 - d. D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
 - e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
 - f. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
 - 3. American Water Works Association (AWWA):
 - a. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
 - b. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
 - c. C504, Standard for Rubber-Seated Butterfly Valves.
 - d. C507, Standard for Ball Valves, 6 IN through 48 IN (150 MM through 1200 MM).
 - e. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
 - f. C550, Standard for Protective Coatings for Valves and Hydrants.
 - g. C606, Standard for Grooved and Shouldered Joints.
 - 4. American Water Works Association/American National Standards Institute (AWWA/ANSI):
 - a. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. MG 1, Motors and Generators.
 - 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).

1.3 DEFINITIONS

- A. The following are definitions of abbreviations used in this Specification Section or one of the individual valve sections:
 - 1. CWP: Cold water working pressure.
 - 2. SWP: Steam working pressure.
 - 3. WOG: Water, oil, gas working pressure.
 - 4. WWP: Water working pressure.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Valve pressure and temperature rating.
 - d. Valve material of construction.
 - e. Special linings.
 - f. Valve dimensions and weight.
 - g. Valve flow coefficient.
 - h. Wiring and control diagrams for electric or cylinder actuators.
 - i. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations per Section 01 61 03.
 - 2. Test reports.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Informational Submittals:
 - 1. Verification from valve actuator manufacturer that actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted, and that the valve actuator responds correctly to the valve position command.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, refer to individual valve Specification Sections for acceptable manufacturers.

2.2 MATERIALS

- A. Refer to individual valve Specification Sections.

2.3 VALVE ACTUATORS

- A. Valve Actuators - General:
 - 1. Provide actuators as shown on Drawings or specified.
 - 2. Counter clockwise opening as viewed from the top.
 - 3. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.
 - 4. Size actuator to produce required torque with a maximum pull of 80 LB at the maximum pressure rating of the valve provided and withstand without damage a pull of 200 LB on handwheel or chainwheel or 300 FT-pounds torque on the operating nut.
 - 5. Unless otherwise specified, actuators for valves to be buried, submerged or installed in vaults or manholes shall be sealed to withstand at least 20 FT of submergence.
 - 6. Extension stem:
 - a. Install where shown or specified.
 - b. Solid steel with actuator key and nut, diameter not less than stem of valve actuator shaft.
 - c. Pin all stem connections.
 - d. Center in valve box or grating opening band with guide bushing.
- B. Buried Valve Actuators:
 - 1. Provide screw or slide type adjustable cast iron valve box, 5 IN minimum diameter, 3/16 IN minimum thickness, and identifying cast iron cover rated for traffic load.
 - 2. Box base to enclose buried valve gear box or bonnet.
 - 3. Provide 2 IN standard actuator nuts complying with AWWA C500, Section 3.16.

4. Provide at least two tee handle keys for actuator nuts, with 5 FT extension between key and handle.
 5. Extension stem:
 - a. Provide for buried valves greater than 4 FT below finish grade.
 - b. Extend to within 6 IN of finish grade.
 6. Provide concrete pad encasement of valve box as shown for all buried valves unless shown otherwise.
- C. Plastic Valve Vault:
1. Provide in non-traffic areas only on valve applications 3-1/2 IN and less.
 2. Nominal 7-1/2 IN DIA top section.
 3. Design unit for screw type extension section having nominal 9 IN DIA bell.
 4. Cast iron ring and lid.
 5. Constructed of injection molded polyolefin compound with fibrous inorganic component reinforcing and UV stabilization.
 6. Armor Access Boxes.
- D. Exposed Valve Manual Actuators:
1. Provide for all exposed valves not having electric or cylinder actuators.
 2. Provide handwheels for gate and globe valves.
 - a. Size handwheels for valves in accordance with AWWA C500.
 3. Provide lever actuators for plug valves, butterfly valves and ball valves 3 IN DIA and smaller.
 - a. Lever actuators for butterfly valves shall have a minimum of five intermediate lock positions between full open and full close.
 - b. Provide at least two levers for each type and size of valve furnished.
 4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 IN DIA and larger.
 5. Provide gearing for gate valves 20 IN and larger in accordance with AWWA C500.
 6. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.
 7. Provide chain actuators for valves 6 FT or higher from finish floor to valve centerline.
 - a. Cadmium-plated chain looped to within 3 FT of finish floor.
 - b. Equip chain wheels with chain guides to permit rapid operation with reasonable side pull without "gagging" the wheel.
 - c. For smaller valves with lever or handle operators, provide offset tee handles with attached chain for operation from the operating floor.
 8. Provide cast iron floor stands where shown on Drawings.
 - a. Stands to be furnished by valve manufacturer with actuator.
 - b. Stands or actuator to include thrust bearings for valve operation and weight of accessories.
- E. Submerged Actuators:
1. Mount the valve actuator on top of an extension bonnet 3 FT above any adjacent personnel access.
 2. The valve and bonnet connection shall be flanged and watertight.
 3. Provide a top brace support for the bonnet.
 - a. Mount the brace 6 IN below the top of the wall as shown.
 4. Materials:
 - a. Extension bonnet: Cast iron ASTM A126 or steel.
 - b. Brace and anchor bolts: Type 304 stainless steel.
- F. Electric Actuators (480 V, 3 PH):
1. Electric Motor Actuators - General:
 - a. Provide electric motor actuators for valves and gates so indicated: on the Drawings, in valve schedule in the Specifications, or elsewhere in the Contract Documents.

- b. Unless otherwise specified, provide each electric motor actuator with integral control devices for operation, including pushbuttons. When actuator's integral control station would be 6 FT or more above the nearest operating floor, or when integral control station would be out of reach of facility personnel standing on the nearest operating floor: (1) integral control station on actuator is not required; and (2) provide remotely-located control station, with pushbuttons, in accordance with this Section.
2. Furnish electric actuator integral with valve consisting of:
 - a. Motor.
 - b. Gearing.
 - c. Handwheel.
 - d. Limit and torque switches.
 - e. Lubricants.
 - f. Heating elements.
 - g. Wiring.
 - h. Terminals for motor power and controls.
 - i. Drive nut.
 3. Housing/enclosure:
 - a. Provide cast iron gear housing and cast iron load bearing enclosure.
 - b. Non load bearing enclosure and housing: Aluminum or cast iron.
 - c. Rated for area classification shown on Drawings.
 - d. Provide O-ring seals for covers and entries.
 - e. Terminal and limit switch compartment covers are to be fastened to gear housing by stainless steel fasteners with capture device to prevent loss.
 4. Motors:
 - a. Provide motors that are totally enclosed, high torque design made expressly for valve actuator service and capable of operating the valve under full differential pressure for complete open-close and reverse cycle of travel at least twice in immediate succession without overheating.
 - b. Design motors in accordance with NEMA MG 1 standards, with Class B insulation, and to operate successfully at any voltage within 10% above or below rated voltage.
 - c. Provide positive method to ensure motor bearings are permanently lubricated.
 - d. Provide three thermal switches imbedded in windings:
 - 1) 120 DEG apart.
 - 2) Provide motor shutdown at high temperature.
 - e. Motor housing:
 - 1) Aluminum or cast iron.
 - 2) Totally enclosed nonventilated with cooling fins.
 - f. Provide motor capable of operating in any position.
 - g. Provide motor sealed from gearcase to allow any mounting position.
 - h. Provide motors suitable for 480 V, 3 PH, 60 Hz.
 5. Gearing:
 - a. Provide power gearing consisting of heat treated steel helical gears, carburized and hardened alloy steel worm, and alloy bronze worm gear, all grease or oil bath lubricated, designed for 100% overload, and effectively sealed against entrance of foreign matter.
 - b. Provide gearing mechanism constructed to permit field changes of reduction gear ratio.
 - c. Design actuators so that motor comes up to speed before stem load is encountered in either opening or closing operation.
 - d. Limit switch gearings and feedback device reduction gearing:
 - 1) Steel or bronze.
 - e. Support rotating shafts with anti-friction bearings.
 - f. Provide separate drive nut/thrust bearing assembly:
 - 1) Mounted to base of actuator.
 - 2) High tensile bronze.
 - 3) Quarter turn actuator: Provide 90 DEG mounting intervals.
 - 4) Provide grease fitting on drive assembly.

6. Handwheel:
 - a. Permanently attached for manual operation.
 - b. Positive declutch mechanism to engage and disengage handwheel.
 - c. Handwheel shall not rotate during motor operation.
 - d. Inoperable motor shall not prevent manual operation.
7. Limit torque and thrust loads in both closing and opening directions by torque limit switches.
 - a. Provide torque switches with micrometer adjustment and reference setting indicator.
 - 1) Assure adjustment variation of approximately 40% in torque setting.
 - b. Provide switches having rating of not less than 6 A at 120 VAC and 2.2 A at 115 VDC.
 - c. Limit and torque switches shall have totally sealed contacts.
8. Furnish electric actuator with two geared limit switch assemblies with each switch assembly having four separate limit switches:
 - a. Assure each limit switch assembly is geared to driving mechanism and is independently adjustable to trip at any point at and between the fully open and fully closed valve position.
 - b. Provide minimum of two normally open contacts and two normally closed contacts at each end of valve travel.
 - c. Provide switches with inductive contact rating of not less than 6 A at 120 VAC, 3 A at 240 VAC, 1.5 A at 480 VAC, 2.2 A at 115 VDC and 1.1 A at 230 VDC.
 - d. Limit switches shall be fully adjustable when power is applied to actuator.
9. Provide space heating elements sized to prevent condensation in both motor and geared limit switch compartment(s).
 - a. Furnish heating elements rated at 120 VAC with heaters continuously energized.
10. Open-close actuator controls:
 - a. Provide control assembly with necessary holding relays, reversing starter, control transformers of sufficient capacity to provide control power, space heating element power and valve position transmitter.
 - b. Provide control assembly in an enclosure rated for the defined area classification.
 - c. Controls for open/close actuator:
 - 1) Provide remote pushbutton station with enclosure rated for area classification shown on Drawings with:
 - a) Open pushbutton.
 - b) Close pushbutton.
 - c) Stop pushbutton.
 - d) Remote/local switch.
 - e) Full open light.
 - f) Full close light.
 - g) Open and close relays as required.
 - 2) Provide control enclosure to accept:
 - a) Remote open/close switches.
 - 3) Provide contacts in control enclosure:
 - a) Remote/local contact.
 - b) Full open contact.
 - c) Full close contact.
 - 4) Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.
11. Additional requirements for modulating valve actuators:
 - a. Proportional position servo-amplifier mounted integral with the actuator control compartment.
 - b. Positioning of valve shall be proportional to a 4-20 mA signal input to the position servo-amplifier when remote control has been selected.
 - c. Servo-amplifier adjustments shall include zero, span, gain, and dead-band.
 - d. Provide 4-20 mA signal position control as shown on the Drawings that interfaces with the position control/position feedback instrumentation wiring to and from [remote control device] [PLC].

12. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes. See Section 01 61 03 for information on how to determine the available fault current, such that, the SCCR rating meets or exceeds the available fault current.

G. Electric Actuators (120 V, 1 PH):

1. Electric Motor Actuators - General:
 - a. Provide electric motor actuators for valves and gates so indicated: on the Drawings, in valve schedule in the Specifications, or elsewhere in the Contract Documents.
 - b. Unless otherwise specified, provide each electric motor actuator with integral control devices for operation, including pushbuttons. When actuator's integral control station would be 6 FT or more above the nearest operating floor, or when integral control station would be out of reach of facility personnel standing on the nearest operating floor: (1) integral control station on actuator is not required; and (2) provide remotely-located control station, with pushbuttons, in accordance with this Section.
2. General:
 - a. Self contained including motor, gearing, torque switch, limit switches and cast housing.
 - b. Electrical enclosure: NEMA 4 or NEMA 7 to comply with area rating classification shown on Drawings.
 - c. Factory assembled requiring only field connection of power and control wires.
 - d. Comply with Section 01 61 03.
3. Motors:
 - a. Produce 1.5 times the required torque.
 - b. Sized for two complete open-close cycles without overheating.
 - c. One fully closed to fully open cycle to occur within 60 SEC.
 - d. Class F insulation.
 - e. Operate at plus or minus 10% voltage.
 - f. 120 Volt, single phase, 60 Hz.
 - g. Provide thermal cutout switch and internal heater for actuator enclosure.
 - h. Control wiring as shown on Drawing control diagrams.
4. Remote pushbutton station:
 - a. Enclosure: NEMA 4 stainless steel.
 - b. Control relays shall include:
 - 1) Open relay.
 - 2) Closed relay.
 - 3) [Remote control device] [PLC] interface relay.
 - c. Push-to-test indicating lights shall include:
 - 1) Open.
 - 2) Closed.
 - 3) Remote.
 - d. Selector switches shall include:
 - 1) Local-Remote.
 - 2) Open-Close.
 - e. Space heater for enclosure.
 - f. Control wiring as shown on control diagrams.
 - g. Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.
5. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes. See Section 01 61 03 for information on how to determine the available fault current, such that, the SCCR rating meets or exceeds the available fault current.

H. Cylinder Actuators:

1. General:
 - a. Self-contained unit including actuator and controls.
 - b. Electrical enclosure to meet area classification shown on Drawings.
 - c. Factory assembled requiring field supply connection and control wires.

2. Cylinders:
 - a. Conform to [AWWA C541] [AWWA C542], [hydraulic] [pneumatic] cylinders.
 - b. Cylinder barrel: [Fiberglass-reinforced plastic] [Stainless steel].
 - c. Heads and caps: [Suitable nonmetallic material] [Ductile iron].
 - d. Cylinder pistons: [Suitable nonmetallic material] [Ductile iron].
 - e. Double acting and operate on 60 PSIG water or air supply.
 - f. Cylinder rated for 150 PSIG.
 - g. Any hoses between control and cylinder to be oil resistant and arranged to avoid sharp bending from hose weight.
 - h. Provide supply filter.
 - i. Position cylinder above or to side of valve.
 - j. For pneumatically operated pump check service provide air-oil tandem cylinder actuator with speed control valves on oil cylinder.
3. Controls:
 - a. Provide pre-piped, pre-wired control:
 - 1) Pipe with corrosion-resistant metal.
 - 2) Provide four-way, two-position, 110 V solenoid valve in weatherproof enclosure.
 - 3) Provide open-closed signal limit switches.
 - 4) Speed control valves, to independently control opening and closing speed between 10 and 60 SEC.
 - 5) Manual-automatic selector valve on supply to solenoid.
 - 6) For modulating valves, provide a positioner, input signal 4-20 mA, including signal converter.
 - 7) For modulating valves, provide valve position transmitter, 4-20 mA, including signal converter, where shown.
 - 8) For pump check valves, provide additional two-way solenoid valve with speed control to allow rapid close on loss of electric power.
- I. Valve Lockout Devices:
 1. Device manufactured from same material as valve operator, preventing access to valve operator, to accept lock shackle.

2.4 FABRICATION

- A. End Connections:
 1. Provide the type of end connections for valves as required in the Piping Schedules presented in Section 40 05 00 or as shown on the Drawings.
 2. Comply with the following standards:
 - a. Threaded: ASME B1.20.1.
 - b. Flanged: ASME B16.1, Class 125 unless otherwise noted or AWWA C207.
 - c. Bell and spigot or mechanical (gland) type: AWWA/ANSI C111/A21.11.
 - d. Soldered: ASME B16.18.
 - e. Grooved: Rigid joints per Table 5 of AWWA C606.
- B. Refer to individual valve Specification Sections for specifications of each type of valve used on Project.
- C. Nuts, Bolts, and Washers:
 1. Wetted or internal to be bronze or stainless steel.
 - a. Exposed to be zinc or cadmium plated.
- D. On Insulated Piping: Provide valves with extended stems to permit proper insulation application without interference from handle.
- E. Epoxy Interior Coating: Provide epoxy interior coating for all ferrous surfaces in accordance with AWWA C550.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Painting Requirements: Comply with Section 09 96 00 for High Performance Industrial Coatings.
- C. Setting Buried Valves:
 - 1. Locate valves installed in pipe trenches where buried pipe indicated on Drawings.
 - 2. Set valves and valve boxes plumb.
 - 3. Place valve boxes directly over valves with top of box being brought to surface of finished grade.
 - 4. Install in closed position.
 - 5. Place valve on firm footing in trench to prevent settling and excessive strain on connection to pipe.
 - 6. After installation, backfill up to top of box for a minimum distance of 4 FT on each side of box.
- D. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.
- E. For grooved coupling valves, install rigid type couplings [or provide separate support to prevent rotation of valve from installed position].
- F. Install electric or cylinder actuators above or horizontally adjacent to valve and gear box to optimize access to controls and external handwheel.
- G. For threaded valves, provide union on one side within 2 FT of valve to allow valve removal.
- H. Install valves accessible for operation, inspection, and maintenance.

3.2 ADJUSTMENT

- A. Adjust valves, actuators and appurtenant equipment to comply with Section 01 75 00.
 - 1. Operate valve, open and close at system pressures.
- B. For all 120 VAC and 480 VAC electric actuators, employ and pay for services of valve actuator manufacturer's field service representative to:
 - 1. Inspect valve actuators covered by this Specification Section.
 - 2. Supervise adjustments and installation checks:
 - a. Open and close valves electrically under local manual and demonstrate that all limit switches are properly adjusted and that switch contacts are functioning properly by verifying the inputs are received at the remote input/output (RIO) panels or local control panel as appropriate.
 - b. Position modulating valves electrically under local manual control and demonstrate that the valve position feedback potentiometer is properly adjusted and that the feedback signal is received at the RIO panels or local control panel as appropriate.
 - c. Simulate a valve position command signal at the RIO panel or local control panel as appropriate and demonstrate that the valve is controlled to the desired position without excessive hunting.
 - 3. Provide Owner with a written statement that the valve actuator manufacturer has verified that the actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted and that the valve actuator responds correctly to the valve position command.

3.3 VALVE SCHEDULE

END OF SECTION

SECTION 40 05 52
MISCELLANEOUS VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Automatic control valves:
 - a. Altitude valves.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 40 05 51 - Valves - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. American Water Works Association (AWWA):
 - a. C512, Standard for Air-Release, Air-Vacuum, and Combination Air Valves for Waterworks Service.
 - b. C550, Standard for Protective Interior Coatings for Valves and Hydrants.
 - 3. Canadian Standards Association (CSA).
 - 4. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 40 05 51.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

2.2 AUTOMATIC CONTROL VALVES FOR WATER SERVICE

- A. Basic Valve:
 - 1. Type:
 - a. Diaphragm-actuated hydraulically operated.
 - 1) Acceptable manufacturers (Model as shown for specific valve):
 - a) Cla-val.
 - b) Singer.
 - 2) Materials:
 - a) Body: Ductile iron.
 - b) Seat insert: Stainless steel.
 - c) Disc: Buna-N.
 - d) Diaphragm: Nylon fabric bonded with synthetic rubber.
 - 3) Design requirements: Do not use diaphragm as seating surface.
 - b. Differential piston hydraulically operated:
 - 1) Acceptable manufacturer:
 - a) GA Industries.
 - 2) Materials:
 - a) Body: Cast iron.

- b) Piston, liner and seat crown: Bronze.
 - c) Piston cup and liner cup: Leather or Buna-N.
 - 3) Design requirements: Valve liner with vee-port openings.
 - 2. Design requirements:
 - a. Size: [_____] IN.
 - b. Operating pressure:
 - 1) Maximum [_____] PSI.
 - 2) Minimum [_____] PSI.
 - c. Flow range:
 - 1) Normal maximum [_____] GPM.
 - 2) Normal minimum [_____] GPM.
- B. Control:
 - 1. Type:
 - a. Altitude control:
 - 1) Acceptable manufacturers:
 - a) Cla-val.
 - b) GA Industries.
 - c) Watts ACV 127 Series.
 - d) Singer Model 106-A-2.
 - 2) Design requirements:
 - a) Modulate basic valve to control high water level in the reservoir.
 - b) Close valve at high water level and open when water level lowers.
 - b. Electric check control:
 - 1) Acceptable manufacturers:
 - a) GA Industries, Figure 1730-D.
 - b) Cla-val, Model 60-31.
 - c) Watts ACV 413-21.
 - d) Singer, Model 106-PG-BPC.
 - 2) Design requirements:
 - a) Control opening and closing speed of basic valve to minimize surge associated with starting and stopping of a pump.
 - b) Design normal opening and closing to be concurrent with pump operation.
 - c) Provide for a more rapid valve closure in event of power outage.
 - d) Provide adjustable controlled rates for all opening and closing speeds.
 - c. Float controlled:
 - 1) Acceptable manufacturers:
 - a) Cla-val, Model CFI.
 - b) GA Industries, Figure 5600-D.
 - c) Watts ACV 110-14.
 - d) Singer, Model 106-F-5.
 - 2) Design requirements:
 - a) Float-operated pilot valve to open or close basic valve at a controlled rate.
 - b) Connect float to pilot with parallel linkage to provide vertical float travel.
 - c) Design float to move freely on float rod between adjustable collars to allow 18 IN of float travel before activating pilot valve.
 - 2. Design requirements:
 - a. Assembles all control features and hardware on basic valve at factory.
 - b. Use corrosion-resistant metal for all exposed portions of the control.
 - c. Include with valve control:
 - 1) Stop valves.
 - 2) Strainer.
 - 3) Valves for opening and closing speed control.
 - 4) Pilot valves.
 - 5) Solenoid valves.
 - 6) Pressure switches as necessary to provide control function.

- d. Electric components:
 - 1) 110 V, 1 PH.
 - 2) In weatherproof enclosure unless shown otherwise on the Drawings.

2.3 ACCESSORIES

- A. Furnish any accessories required to provide a completely operable valve.

2.4 FABRICATION

- A. Completely shop assemble unit including any interconnecting piping, speed control valves, control isolation valves and electrical components.
- B. Provide internal epoxy coating suitable for potable water for all iron body valves in accordance with AWWA C550.

2.5 SOURCE QUALITY CONTROL

- A. Shop hydrostatically test to piping system test pressure.

2.6 MAINTENANCE MATERIALS

- A. Provide one set of any special tools or wrenches required for operation or maintenance for each type valve.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: See Specification Section 40 05 51.
- B. Float-Operated Valves: Install baffle around float to minimize turbulence adjacent to float.

3.2 FIELD QUALITY CONTROL

- A. Clean, inspect, and operate valve to ensure all parts are operable and valve seats properly.
- B. Check and adjust valves and accessories in accordance with manufacturer's instructions and place into operation.

END OF SECTION

SECTION 40 05 61
GATE VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Gate valves.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 40 05 51 - Valves - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. American Water Works Association (AWWA):
 - a. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
 - b. C504, Standard for Rubber-Seated Butterfly Valves.
 - c. C550, Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.
 - 3. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
 - a. SP-9, Spot Facing for Bronze, Iron and Steel Flanges.
 - b. SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - c. SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.3 DEFINITIONS

- A. OS&Y: Outside Screw and Yoke.
- B. NRS: Non-rising Stem.
- C. RS: Rising Stem.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 40 05 51.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

2.2 VALVES: WATER (HOT, COLD, HEATING, COOLING, SERVICE, PROCESS, POTABLE, NON-POTABLE, AND WASTEWATER)

- A. Double Disc Gate Valve, 3 to 12 IN (Water Application):
 - 1. Comply with AWWA C500.
 - 2. Materials:
 - a. Seating surfaces, stems, stem nut: Bronze.
 - b. Body, disc: Cast iron.
 - 3. Design requirements:
 - a. 200 PSI working pressure.
 - b. Buried: NRS, O-ring stem seal, 2 IN operation nut.

- c. Exposed: [NRS, O-ring stem seal, handwheel] [OS&Y, RS, stuffing box stem seals, handwheel].
 - 4. Manufacturers:
 - a. American Flow Control.
 - b. Clow.
 - c. M&H.
 - d. Mueller.
- B. Resilient Wedge Gate Valves, 2 to 48 IN (Water, Wastewater Application):
 - 1. Comply with AWWA C509.
 - 2. Materials:
 - a. Stem and stem nut: Bronze.
 - 1) Wetted bronze parts in low zinc bronze.
 - 2) Aluminum bronze components: Heat treated per AWWA C504.
 - b. Body, gate: Cast iron or Ductile iron.
 - c. Resilient wedge: Fully encapsulated rubber wedge. Styrene Butadiene Rubber (SBR).
 - 3. Design requirements:
 - a. Minimum 200 PSIG working pressure.
 - b. Buried: NRS, O-ring stem seal, 2 IN square operating nut.
 - c. Exposed: OS&Y, stuffing box stem seal, handwheel or NRS, O-ring, stem seal, handwheel.
 - d. Counter clockwise open rotation.
 - e. Fusion bonded epoxy coating interior and exterior except stainless steel and bearing surfaces.
 - 1) Comply with AWWA C550.
 - 2) Wetted bronze parts in low zinc bronze.
 - 3) Aluminum bronze components: Heat treated per AWWA C504.
 - 4. Manufacturers:
 - a. Clow.
 - b. Mueller.
 - c. American Flow Control.
 - d. M & H.
- C. Double Disc Gate Valves, 14 to 48 IN (Water, Wastewater Application):
 - 1. Comply with AWWA C500.
 - 2. Materials:
 - a. Seating surfaces, stem, stem nut: Bronze.
 - b. Body, discs: Cast iron.
 - 3. Design requirements:
 - a. 150 PSI working pressure.
 - b. NRS O-ring stem seal.
 - c. Provide gear actuator, 20 IN and larger valves.
 - d. Provide roller tracks and scrapers for horizontal valves size 16 IN and larger.
 - e. Provide bypass valve sized per AWWA C500.
 - 4. Manufacturers:
 - a. Clow.
 - b. Mueller.
 - c. American Flow Control.
 - d. M & H.

2.3 ACCESSORIES

- A. Refer to Drawings and valve schedule for type of actuators.
 - 1. Furnish actuator integral with valve.
- B. Refer to Specification Section 40 05 51 for actuator requirements.

2.4 FABRICATION

- A. General:
 - 1. Provide valves with clear waterways the full diameter of the valve.
- B. Spot valves in accordance with MSS SP-9.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Specification Section 40 05 51.
- B. Where larger buried valves utilize smaller bypass valves, provide a second valve box installed over the bypass valve operating nut.
- C. Do not install gate valves inverted or with the stems sloped more than 45 DEG from the upright unless the valve was ordered and manufactured specifically for this orientation.

END OF SECTION



DIVISION 46

WATER AND WASTEWATER EQUIPMENT



SECTION 46 41 00

MIXERS

PART 1 - GENERAL

1.1 SUMMARY

- A. The Hydrodynamic Mixing System (HMS) is defined as a supplemental system installed within a potable water storage reservoir which passively utilizes the energy provided by the inlet water supply (via pumped or gravity head) and generates a sufficient inlet momentum to achieve a complete homogeneous blending of the water volume within the reservoir with the inlet supply flow. Determination of Complete Homogeneous Blending shall be defined by the modeling requirements and supporting hydraulic analysis as conducted by each individual manufacturer for their specific system configuration as defined within these specifications. System submittals not providing this validation shall not be considered as a viable Hydrodynamic Mixing System (HMS) and shall not be accepted as an equivalent to this system specification.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. American Bearing Manufacturers Association (ABMA).
 2. American Gear Manufacturers Association (AGMA):
 - a. 390.03a, Gear Handbook - Gear Classification, Materials and Measuring Methods for Bevel, Hypoid, Fine Pitch Wormgearing and Racks Only as Unassembled Gears.
 3. American National Standards Institute (ANSI)
 - a. B16.1 – Cast Iron Pipe Flanges and Flanged Fittings
 - b. B16.5 – Pipe Flanges and Flanged Fittings
 - c. B36.10 – American National Standard Weights and Dimensions of Welded and Seamless Wrought Steel Pipe
 4. American Society for Testing and Materials (ASTM)
 - a. A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - b. A234 – Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
 - c. A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - d. A351 – Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
 - e. A536 – Standard Specification for Ductile Iron Castings
 - f. C110 – Ductile Iron and Gray-Iron Fittings, 3 In. through 48 In. for Water
 - g. D1330 – Standard Specification for Rubber-Sheet Gaskets
 - h. D1784 – PVC/CPVC Pipe Compounds
 - i. D1785 – PVC Pipe, Schedules 40, 80 & 120
 - j. D2466 – PVC Solvent Cement
 - k. D2855 – PVC Solvent Joints
 - l. D3261 – Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Fittings
 - m. D3915 – PVC Pipe Fitting Compounds
 5. American Iron and Steel Institute (AISI)
 - a. AISI 304 – 304 Stainless Steel Plate
 - b. AISI 316 – 316 Stainless Steel Plate
 - c. AISI 1040 – Carbon Steel Plate
 6. American Water Works Association (AWWA)
 - a. C104 – Cement-Mortar Lining of Ductile Iron Pipe and fittings for Water
 - b. C110 – Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In. for Water
 - c. C115 – Flange Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges

- d. C200 - AWWA Standard for Steel Water Pipe 6" and Larger
- e. C207 – Standard for Steel Pipe Flanges for Waterworks Service – Size 4 In. to 144 In.
- f. C220 – AWWA Standard for Stainless Steel Pipe, 4" and Larger
- g. C900 – AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. for Water Distribution
- h. C905 – AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In Through 48 In. for Water Transmission and Distribution
- i. C906 – AWWA Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 63 In. for Water Distribution
- 7. American Water Works Association Research Foundation (AwwaRF)
 - a. Project No. E20-J08 – Physical Modeling of Mixing in Water Storage Tanks (Forthcoming)
- 8. National Sanitation Foundation (NSF)
 - a. NSF Standard 14 – Plastic Piping System Components and Related Materials
 - b. NSF Standard 61 – Drinking Water System Components – Health Effects

1.3 SUBMITTALS

- A. Independent CFD Modeling Validation
 - 1. The mixing system designer/supplier must supply data or report from at least one project where an independent company conducted CFD modeling on their mixing system design and the modeling results verified the design achieved complete mixing.
- B. Full Scale Tracer Study Validation
 - 1. The mixing system designer/supplier must supply data or report from at least one project where a full scale tracer study using calcium chloride was conducted on a circular reservoir and the tracer study verified their mixing system design achieved complete mixing.
- C. NSF61 Certification
 - 1. Copy of the NSF61 Certified listing for the valves used in the Hydraulic Mixing System (HMS).
 - 2. The valves themselves must be NSF61 certified, not just the elastomer used in construction of the valves. NSF61 approved/certified materials will not be accepted in lieu of valve certification.
- D. Test Report on Elastomer Exposure to Chlorine and Chloramine
 - 1. Copy of test report from an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 "Standard Test Method for Rubber Property – Effect of Liquids."
- E. System Installation Drawings
 - 1. The HMS manufacturer shall be responsible for providing engineering installation drawings of the complete manifold piping system as supplied by the manufacturer. These drawings shall include plan view piping arrangement, sections and elevations as required, support bracket installation details, duckbill nozzle orientation details, and all dimensions required for locating the system within the specified dimensions of the tank.
 - 2. Six (6) sets of plans shall be provided to the Engineer for review and approval.
 - 3. Two (2) sets of final fabrication and installation drawings shall be included with the shipment of the manifold piping equipment.
- F. Design Calculations
 - 1. All Design Calculations, curves, and reference information listed below must originate and be submitted by the duckbill valve manufacturer. Calculations, curves, and reference information provided by contractors relating to the HMS are not allowed. The duckbill valve manufacturer MUST include within the submittal package the following design calculations, curves, and reference information:

- a. Calculations showing the fill time required, under isothermal conditions, for the HMS system to achieve complete mix of the reservoir volume at minimum, average and peak fill rates. Complete mixing defined as 95% homogenous solution. The theory and equations used in calculating the mixing times must be as described in the Rossman, L.A. and W.M. Grayman (1999) reference.
 - b. A representative Computational Fluid Dynamics (CFD) model evaluation of the proposed HMS system configuration applied within a reservoir of similar geometry. Model output documentation shall include all design variables applied for the simulation, plot of the 3-D geometry showing the mesh definition, velocity magnitude vector and contour plots at different cross-sections throughout the water volume, simulated tracer animations showing the spatial and temporal distribution of inlet water in real time during the fill cycle.
 - c. Hydraulic calculations showing the resulting jet velocities of each inlet nozzle at minimum, average, and peak fill rates.
 - d. Hydraulic calculations showing the flow distribution among all inlet ports at minimum, average, and peak fill rates.
 - e. Manifold hydraulic calculations showing the total headloss of the HMS at minimum, average, and peak fill and draw rates. Headloss shall include all minor losses and headloss of nozzles and outlet check valves.
 - f. Hydraulic curves showing thrust vs. flow for the inlet nozzles.
 - g. Hydraulic curves for each outlet check valves showing headloss vs. flow.
 - h. Calculations showing the terminal rise height of the jets that discharge at an angle above horizontal. The terminal rise height shall be calculated assuming 10°F and 20°F colder inlet water and calculated at minimum, average and peak fill rates. The theory and equations used to calculate the terminal rise height shall be included.
 - i. If the calculations and supporting data provided do not show compliance with the hydrodynamic requirements of the system as interpreted by the Engineer or Owner then the submittal shall be rejected.
- G. Installation, Operation and Maintenance Manuals
1. Within 30 days of final approval of the installation drawings, by the Engineer, the HMS valve manufacturer shall provide four (4) sets of the installation portion of the Installation, Operation and Maintenance (IOM) Manuals for the applicable system. Within 30 days of final approval, by the Engineer, of the installed system the manufacturer shall provide six (6) copies of the complete Installation, Operation and Maintenance (IOM) Manual for final review and approval.
 2. The manuals shall be in the following format and include the listed required information as a minimum:
 3. Enclosed in a 3-ring binder with project title and system designation shown on the front cover and side binder.
 4. Table of contents
 - a. Copy of design calculations for the manifold system as defined in the previous section.
 - b. Copy of complete set of the installation plans.
 - c. Copy of NSF61 Certified Listing for the valves
 - d. Parts and equipment list with specification numbers for ordering of replacement parts.
 - e. Product specification sheets for nozzles, outlet valves, expansion joints, concrete anchors, and any other specialized items supplied with the system.
 - f. Installation guidelines for the HMS manifold system.
 - g. Operational procedures for the HMS manifold system.
 - h. Guidelines for repair of system components.
 - i. Schedule for suggested periodic maintenance of the manifold system.
- H. Contract Closeout Information:
1. Operation and Maintenance Data:
 - a. Provide Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturer is Tideflex Technologies, Carnegie, PA 15106.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- A. The specifications in this section include all components of the Reservoir Hydrodynamic Mixing System (HMS) consisting of a bi-directional flow manifold equipped with variable orifice duckbill inlet nozzles and outlet flow check valves that are NSF61 certified. The HMS manufacturer shall be responsible for designing the system in accordance with the hydrodynamic criteria defined within these specifications and submit design calculations verifying compliance in accordance with the submittal requirements. The following is a description of the Hydrodynamic Mixing System.
- B. All modeling and hydraulic and mixing calculations pertaining to the HMS shall originate from the duckbill valve manufacturer. Modeling and calculations provided by parties other than the duckbill valve manufacturer are not allowed.
- C. The complete Hydrodynamic Mixing System shall be supplied by the variable orifice nozzle manufacturer to maintain single source responsibility for the system. The complete system shall be defined as all piping and appurtenances within the tank downstream of the tank penetration. Appurtenances include pipe, fittings, horizontal and vertical pipe supports, expansion joints, variable orifice duckbill check valves, and any other equipment specified within this section of the specifications.
- D. The following describes the design principles of the Hydrodynamic Mixing System and the validation of its effectiveness:
1. To only require one tank penetration for reservoirs that operate in fill-then-draw unless a separate outlet pipe is required.
 2. To comprise one manifold pipe with duckbill inlet nozzles and outlet check valves in order to minimize the amount of pipe, fittings and appurtenances required to separate the inlet and outlet.
 3. To not have any horizontal piping that requires bracing to the tank shell other than at the bottom of the reservoir.
 4. To be passive operating and not require any outside energy source.
 5. To utilize the existing differential pressure between distribution system pressure and tank head to fill the reservoir thru the inlet nozzles and draw fluid from the reservoir thru the outlet check valves.
 6. To achieve complete mixing via multiple turbulent inlet jets (Jet-induced mixing). Scale modeling has shown that multiple ports provide faster mixing than a single inlet port [Roberts, et al (2005)].
 7. To utilize variable orifice inlet nozzles that provides a non-linear jet velocity vs. flow characteristic. This maximizes the inlet momentum at all flow rates. The inlet momentum is the kinetic energy solely responsible for mixing. This also ensures the rise height of negatively buoyant inlet jets will be maximized when the inlet water is colder than the tank water.
 8. To have less than ten (10) inlet ports. Scale modeling has shown diminishing returns with greater port quantities [Roberts, et al (2005)].
 9. To have inlet ports that discharge an elliptically shaped jet that provides faster mixing and dilution of the inlet water into the tank water.
 10. To have outlet check valves separated spatially from the inlet nozzles to mitigate short circuiting.
 11. To have a configuration based on Computational Fluid Dynamics (CFD) modeling, conducted by the manufacturer, of a similar configuration in the same tank style.
 12. To have multiple sampling studies conducted by water utilities that have conducted “before” and “after” spatial sampling of disinfectant residual and/or temperature that have proven the effectiveness of the HMS. Data can be submitted based upon the request of the engineer.

2.3 FABRICATION AND MANUFACTURE

- A. Approved manufacturer is Tideflex Technologies, Carnegie, PA 15106.
- B. Variable Orifice Duckbill Inlet Nozzles
 1. Inlet ports/nozzles shall be duckbill-style check valves that allow fluid to enter the reservoir during fill cycles and prevent flow in the reverse direction through the nozzle during draw periods. Inlet ports/nozzles may not be fixed-diameter ports or pipes.
 2. The duckbill valves shall be NSF61 Certified. NSF61 approved/Certified materials will not be accepted in lieu of valve certification.
 3. Inlet ports/nozzles shall have a variable diameter vs. flow hydraulic profile that provides a non-linear jet velocity vs. flow characteristic and a linear headloss vs. flow characteristic.
 4. The inlet ports/nozzles shall discharge an elliptically shaped jet. The nozzle must have been modeled by an independent laboratory using Laser Induced Fluorescence (LIF).
 5. Manufacturer shall have conducted independent hydraulic testing to determine headloss and jet velocity characteristics on a minimum of eight (8) sizes of duckbill valves ranging from 2” through 48”. The testing must include multiple constructions (stiffness) within each size and must have been conducted for free discharge (discharge to atmosphere) and submerged conditions.
 6. Manufacturer shall have conducted an independent hydraulic test where multiple valves (at least four) of the same size and construction (stiffness) were tested to validate the submitted headloss characteristics and to prove the repeatability of the manufacturing process to produce the same hydraulic characteristics.
 7. Manufacturer shall have conducted independent hydraulic testing to study the flow distribution characteristics of duckbill valves installed on multiport manifolds.
 8. Manufacturer to have conducted Finite Element Analysis (FEA) on various duckbill valves to determine deflection, stress, and strain characteristics under various load conditions. Modeling must have been done for flowing conditions (positive differential pressure) and reverse differential pressure.
 9. Manufacturer must have conducted in-house backpressure testing on duckbill valves ranging from ¾” to 48”.
 10. Manufacturer shall have at least ten (10) years’ experience in the manufacturing of “duckbill” style elastomeric valves.
 11. Manufacturer must have duckbill valves installed on manifold piping systems in at least 50 distribution system reservoirs.
 12. Manufacturer must have representative inspection videos showing the duckbill valves discharging water into the reservoir during an initial fill (unsubmerged). Manufacturer must also have representative underwater inspection videos showing the operation of the valves when submerged. Representative videos can be submitted upon request from the engineer.
 13. The duckbill style nozzles shall be one-piece elastomer matrix with internal fabric reinforcing designed to produce the required discharge velocity and minimum headloss requirements as stipulated in the Submittals section. The flange portion shall be an integral portion of the nozzle with fabric reinforcing spanning across the joint between the flange and nozzle body.
 14. The elastomer used in construction of the duckbill valves must have been tested by an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 “Standard Test Method for Rubber Property – Effect of Liquids.”
 15. The manufacturer’s name, plant location, serial number and product part number which designate nozzle size, material and construction specifications shall be bonded onto the surface of the nozzle.
- C. Outlet Check Valves
 1. The outlet flow valves shall be perforated disc type with elastomeric membrane.
 2. The valves shall be NSF61 Certified. NSF61 approved/Certified materials will not be accepted in lieu of valve certification.

3. The perforated disc shall be fabricated of stainless steel plate with welded support gussets. The disc shall be flanged and drilled to mate with ANSI B16.1, Class 125/ANSI B16.5 Class 150 flanges. The disc shall have three (3) tapped holes used for fastening the membrane and support rod to the disc with stainless steel bolts, nuts, and lock washers. The top of the disc shall be tapped and supplied with lifting eyebolt for installation.
 4. The membrane shall be circular, one piece rubber construction with fabric reinforcement. The diameter of the membrane shall allow adequate clearance between the membrane O.D. and the pipe I.D. The membrane shall be vulcanized with a specified convex radius to produce a compression set to allow the membrane to seal against the perforated disc at low reverse differential pressure.
 5. The support rod shall be stainless steel and drilled with three (3) longitudinal holes to allow fastening of rod to membrane and perforated disc.
 6. When line pressure inside the valve exceeds the backpressure outside the valve, the line pressure forces the membrane to open, allowing flow to pass through the perforations in the disc. When backpressure exceeds the line pressure, the membrane seats on the perforated disc preventing backflow.
 7. The valve allows flow out of the reservoir during draw cycles and prevents flow into the reservoir during fill cycles.
 8. The elastomer used in construction of the membrane must have been tested by an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 "Standard Test Method for Rubber Property – Effect of Liquids."
 9. The manufacturer's name, plant location, serial number and product part number which designate membrane size, material and construction specifications shall be bonded onto the surface of the membrane.
- D. Polyvinyl Chloride (PVC) Pipe and Fittings
1. All PVC pipe and PVC fittings shall be a minimum Schedule 80 in accordance with ASTM D1785-83.
 2. PVC pipe and fittings shall be NSF61 approved for potable water.
 - 3.
 4. PVC pipe compounds shall be in accordance with the standards listed in Section 3.0: Referenced Standards.
 5. PVC solvent and solvent joints shall be in accordance with the standards listed in Section 3.0: Referenced Standards.
 6. Field solvent welding will not be allowed unless approved by the Engineer.
 7. All pipe joints that are to be field connected shall be PVC type flanges. Flange drilling to be in accordance with ANSI B16.1/B16.5.
 8. All fittings shall have the same pressure rating as the pipe unless otherwise noted.
- E. Flange Gaskets
1. Flange gaskets shall be full-faced and shall be in accordance with ASTM D1330.
 2. Flange gasket drilling pattern shall conform to ANSI B16.1/B16.5.
 3. Flange gaskets shall be 1/8" thick.
 4. Gasket material shall be EPDM.
- F. Fasteners
1. Hex head bolts and nuts shall be stainless steel 304 conforming to ANSI/ASME B18.2.1 and ANSI/ASME B18.2.2.
- G. Pipe Supports
1. All components of the bracket assembly shall be stainless steel 304 in accordance with the associated standards.
 2. The bracket assemblies shall consist of four components:
 - a. A base plate (when required). For glass-lined tanks with concrete floors, the base plate will have four thru holes for expansion anchors.
 - b. A top-works weldment that consists of structural channel and angle iron. The TMS piping shall rest on the angle iron. The angle iron has predrilled holes for the U-bolt.

- c. U-bolt with four hex nuts.
 - d. An 1/8" thick EPDM strip with a length equivalent to the circumference of the pipe. The strip shall be placed between the pipe and the angle iron and U-bolt.
 - e. Lateral support bracket assemblies shall be installed at locations noted on the Drawings.
 - f. Lateral supports shall be fastened to the tank sidewall by bolted connections. Bolted connections shall be installed in coordination with tank manufacturer's recommendations.
- 3. The channel of the top-works weldment shall be field fit and modified to the required length. The channel shall then be field welded to the base plate.
 - 4. For glass-lined tanks with concrete floor slabs, the support shall be anchored to the concrete floor with stud type expansion anchors, the pull-out rating of the combined anchors shall be a minimum of 10 times greater than the static weight of the vertical pipe section.
- H. Coatings
- 1. Following installation of the manifold system, all carbon steel and ductile iron pipe, fittings, bolted connections, pipe supports, and appurtenances shall be coated according to the interior tank paint specification as specified by the Engineer.
 - 2. Surface preparation and coating procedures shall be provided by the Engineer and the coating supplier.
 - 3. Tideflex and Waterflex Valves shall not be coated. The valves shall either be masked or be mounted after coating of the tank and piping. Contractor to ensure masking materials are removed after coating.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation of the manifold system shall be in accordance with the installation plans and guidelines provided by the HMS manufacturer and as specified in the installation section of the IOM manual. Refer to section on Submittals for quantities and delivery schedules of the documents.

3.2 FIELD QUALITY CONTROL

- A. Provide manufacturer's field services.

3.3 DELIVERY, STORAGE, AND MATERIAL HANDLING

- A. Individual nozzles and outlet valves shall be packaged separately from the piping equipment.
- B. All flanges shall be protected by using plastic inserts or plank wood, pipe sections are to be fully supported to prevent pipe deflection or damage to fittings or connections.
- C. All equipment shall be shipped on pallets capable of fully supporting the pipe sections across their entire length. Pallets should be accessible for fork lift transport or strap and hoist means without causing any load to the pipe equipment.
- D. All stainless steel components shall be stored separately away from any carbon steel components or other materials that could stain or deface the stainless steel finish from run-off of oxidized ferrous materials.
- E. All pipe equipment should be covered and stored in areas free from contact with construction site sediment erosion to prevent accumulation of materials within the pipe and fittings.
- F. Duckbill nozzles should be protected from contact with rigid objects during handling and storage. The contractor shall be responsible for replacing any duckbill nozzles or elastomeric components that are damaged after arrival on the site through installation and start-up of the system.

3.4 START-UP AND TESTING PROCEDURE

- A. The TMS manufacturer shall provide one (1) day start-up services by a factory representative to verify that the system has been installed in accordance with the design specifications and requirements listed within this section.
- B. Start-Up Flow Testing
 - 1. Following installation of the complete manifold piping system, the contractor shall open the upstream isolation valve to allow flow into the tank through the manifold system. The isolation valve must be opened slowly to prevent surge or over-pressurization of the manifold system. The isolation valve must be fully opened to inspect the flow characteristics of the manifold system.
 - 2. The contractor and factory representative shall visually inspect the entire piping system for leakage.
 - 3. The contractor and factory representative shall visually inspect all of the inlet nozzles to ensure flow is being discharged into the tank through all nozzles.

3.5 SPARE PARTS

- A. Spare parts are not required, unless otherwise specified.

3.6 WARRANTY

- A. The complete manifold piping system shall be supplied by the HMS manufacturer to maintain single source responsibility for the system. The complete system shall be defined as all piping and appurtenances within the tank downstream of the tank penetration. Appurtenances include pipe, fittings, horizontal and vertical pipe supports, expansion joints, duckbill valves, and any other equipment specified within this section of the specifications.
- B. All piping, pipe support brackets, joint connections, expansion joints, and anchors shall be warranted by the HMS manufacturer against failure under design conditions for a period on one (1) year from the date of final installation approval by the Engineer.
- C. Inlet nozzles and outlet valves shall be warranted by the manufacturer against failure under design operating conditions for a period of one (1) year from the date of final installation approval by the Engineer. Elastomer components damaged as a result of maintenance activities, foreign debris, or excessive exposure to direct ultraviolet and thermal radiation shall be excluded warranted coverage.

END OF SECTION