

SECTION 02611 - PIPE AND FITTINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pipe and Fittings for Water and Sewer
- B. Related appurtenances.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 513, Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
 - 2. ASTM A 635, Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Commercial Steel, Drawing Steel, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, Hot-Rolled.
 - 3. ASTM D 2241, Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe.
 - 4. ASTM D 3034, Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 5. ASTM D3139, Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
 - 6. ASTM D 3212, Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - 7. ASTM F 477, Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - 8. ASTM F 789, Type PS-46 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings.
 - 9. ASTM D 2321, Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
- B. American Water Works Association (AWWA):

1. AWWA C110, Gray-Iron and Ductile-Iron Fittings, 3 inch through 48 inch, for Water and Other Liquids.
2. AWWA C111, Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
3. AWWA C150, Thickness Design of Ductile-Iron Pipe.
4. AWWA C151, Ductile-Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
5. AWWA C153, Ductile-Iron Compact Fittings, 3 inch through 24 inch and 54 inch through 64 inch.
6. AWWA C600, Installation of Ductile Iron Water Mains and their Appurtenances.

1.03 RELATED SECTIONS

- A. Section 02221 – Trenching, Backfilling and Compacting
- B. Section 02601- Manholes

1.04 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, catalog cut or other data as required to provide a complete description of piping, fittings and other appurtenances specified herein.
- C. Certificates:
 1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.
 2. Manufacturer's sworn certification that pipe will be manufactured in accordance with specified reference standards for each pipe type.

1.05 QUALITY ASSURANCE

- A. Design Criteria:
 1. Use only one type and class of pipe in any continuous line of sewer

between structures, unless otherwise indicated on the Drawings.

2. Use pipe and fittings designed to withstand imposed trench loadings and conditions at the various locations.

B. Source Quality Control:

1. Shop Tests: In accordance with Article 4, paragraph 4.5 of the General Conditions, factory test pipe materials listed in the following. Each pipe manufacturer must have facilities to perform listed tests. The ENGINEER reserves the right to require the manufacturer to perform such additional number of tests as the ENGINEER may deem necessary to establish the quality of the material offered for use.

	<u>Material</u>	<u>Test Method</u>	<u>Number of Tests</u>
a.	Ductile Iron Pipe	ANSI A 21.51	As specified in ANSI A 21.51
b.	Polyvinyl Chloride specified in Pipe	ASTM D 3034	As ASTM D 3034

2. Laboratory Tests: The ENGINEER reserves the right to require that laboratory tests also be conducted on materials that are shop tested. Furnish without compensation, labor, materials, and equipment necessary for collecting, packaging, and identifying representative samples of materials to be tested and the shipping of such samples to the Testing Laboratory.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Transport, handle and store pipe materials and other Products specified herein in a manner recommended by the respective manufacturers to prevent damage and defects.

1.07 SITE CONDITIONS

A. Environmental Requirements:

1. Keep trenches dewatered until pipe joints have been made and concrete cradle and encasement, if any, have cured.
2. Under no circumstances lay pipe in water or on bedding containing frost.

3. Do not lay pipe when weather conditions are unsuitable, as determined by the ENGINEER, for pipe laying work.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

- A. For pipe joints, use rubber gaskets suitable for conveying domestic sewage.
- B. Polyvinyl Chloride Pipe (PVC) - SDR 35:
 1. Manufacturers:
 - a. J. M. Manufacturing Co.
 - b. Extrusion Technologies, Inc.
 - c. Carlon
 - d. or equal
 2. Pipe: Type PSM SDR-35, ASTM D 3034 (4"-15"), or Type PS-46, ASTM F 789 (4"-18").
 3. Fittings: Conforming to same applicable ASTM Specification requirements for pipe.
 4. Joints: ASTM D3212 push-on joint with ASTM F477 elastomeric gasket. Gasket shall be locked in groove of bell to prevent displacement when pipes are joined.
- C. Ductile Iron (DIP):
 1. Manufacturers:
 - a. Griffin Pipe Products, SewperCoat Lined
 - b. Clow Water Systems Corporation
 - c. U.S. Pipe
 - d. or equal
 2. Pipe: ANSI/AWWA C151/A21.51.
 3. Wall Thickness Class: ANSI/AWWA C150/A21.50, Class as follows:
 - a. Exterior Below Grade Piping: Class according to table below.

Depth	Pipe Diameter	
	3"-14"	16"-48"
<10'	52	52
10'-14'	52	54
>14'	54	56

- b. Interior/Exposed Piping: Class 53, unless higher class dictated by manufacturer.
 4. Fittings:
 - a. Ductile Compact Fittings: ANSI\AWWA C153/A21.53, Class 350, diameters 4" through 16".
 - b. Ductile Standard Fittings: ANSI\AWWA C110/A21.10, Class 250, diameters 18" through 24".
 5. Joints:
 - a. Buried Joints:
 1. Push-on: ANSI/AWWA C111/A21.11.
 2. Mechanical: ANSI/AWWA C111/A21.11.
 - b. Exposed/Interior Joints: Flanged: ANSI A21.15 with ANSI B16.21 1/16 inch thick cloth insertion rubber face gaskets. ANSI B18.2 nuts and bolts.
 6. Pipe and Fittings Coating:
 - a. Outside: ANSI/AWWA C151/A21.51, factory coated with bituminous paint, minimum 1 mil dry thickness.
 - b. Interior: ANSI/AWWA C104/A21.4, factory coated with calcium aluminate mortar made of fused calcium aluminate cement and fused calcium aluminate aggregates equivalent to SewperCoat as manufactured by Lafarge Calcium Aluminates. Lining thickness shall be as follows:
 - 1) 6 through 12-inch diameter: 0.125-inches
 - 2) 14 through 24-inch diameter: 0.1875-inches

- D. Polyvinyl Chloride (PVC) Pipe/Schedule 40 and 80:
1. Manufacturers:
 - a. Bristol Pipe
 - b. Cresline Plastic Pipe
 - c. or equal
 2. Pipe: ASTM D1784 and D1785, schedule 40 and 80 as indicated on Drawings.
 3. Fittings: ASTM D2467, Schedule 80 unless noted otherwise on Drawings.
 4. Joints: Solvent cement socket type unless flanged joints are indicated on Drawings.
 5. Flanges: PVC Schedule 80, 150 lb flanges. Flanges shall be solvent welded to pipe according to ASTM D2855.
 - a. Gaskets: Soft rubber full face flat-type.
 - b. Nuts and Bolts: ANSI B18.2.
 6. Solvent: ASTM D2564.
- E. Polyvinyl Chloride Pipe – PVC AWWA C900
1. Manufacturers
 - a. J-M Pipe, Blue Brute
 - b. Extrusion Technologies, Inc.
 - c. Certainteed
 - d. Or equal
 2. Pipe: AWWA C 900, Class 200, DR 14 pressure pipe manufactured to cast iron or ductile iron outside dimensions.
 3. Fittings: Ductile iron as specified under Ductile Iron Pipe elsewhere in this Section.
 4. Joints: ASTM D 3139 compression gasket ring with ASTM F 477 elastomeric seals.
- F. High Density Polyethylene Pipe (HDPE)

1. Manufacturers
 - a. PolyPipe EHMW, Rinker Materials
 - b. or equal
2. Pipe: High density, extra high molecular weight (EHMW) polyethylene with PE3408 standard thermoplastic designation code and having an ASTM D3350 cell classification of 345464E. Pipe shall be manufactured according to ASTM F714 and/or ASTM D3055. Pipe shall be marked on body or hub to indicate the applicable standards.
 - a. Dimension Ratio (DR): 13.5
 - b. Pipe Dimensions: Outside diameter same as ductile iron (DIPS).
3. Fittings: Polyethylene meeting pipe specifications and appropriate requirements of AWWA C-901 and AWWA C-906.
4. Joints: Thermal butt fusion type.
 - a. Butt fusions performed between pipe or pipe ends and fitting outlets shall be within the following allowable wall mismatches:
 - 1) 6-inch IPS and smaller: 2DR
 - 2) 6-inch through 18-inch IPS: 1DR
 - 3) >18-inches: No difference

G. Polyethylene Pipe (PE):

1. Manufacturers
 - a. Polystar, Inc.
 - b. or equal
2. AWWA C901, SDR 9 copper tube size made of PE 3408 type resin conforming to ASTM D 2737.
3. Pressure Rating: 200-psi minimum.
4. Fittings: Compression type equivalent to Mueller Insta-tite or 110 Series or Ford Pack-Joint.
5. Insert Stiffeners: Install corporation stops, curb stops and other

fittings utilizing insert stiffeners as manufactured by Ford Meter Company or Mueller Company. Secure stiffeners with stainless steel hose clamps

H. Copper Tubing

1. Underground

- a. Tubing: ASTM B88 Type K annealed.
- b. Joints: Compression type.

2. Above Ground

- a. Tubing: ASTM B 88 Type L drawn tempered.
- b. Joints: Solder
- c. Fittings:
 - 1) Wrought copper or bronze solder joints fittings, ANSI B16.22.
 - 2) Cast bronze solder joint fittings ANSI B16.18
- d. Solder: ASTM B32 alloy grade 95TA (95/5 tin-antimony). Use flux recommended by solder manufacturer.

2.02 VALVES

A. Gate Valves (2-1/2" diameter and larger)

1. Manufacturers

- a. Mueller.
- b. American Flow Control
- c. Or equal.

2. General: AWWA C 509 resilient seat wedge type designed for 150 psi operating pressure.

- a. Buried: Non-rising stem.

3. Valve Body: ASTM A 126, Class B cast iron.

4. Resilient Wedge: ASTM A 536 ductile iron created with nitrite rubber.
 5. Stem: ASTM B 763 bronze with two (2) upper and one (1) lower nitrite rubber O-ring seals.
 6. End Connections:
 - a. Buried service: Mechanical joint.
 - b. Interior/Exposed: ANSI B16.1, 125 pound flanged.
 7. Provide square operating nut and valve box for buried service. Provide T-wrench for operating buried valves.
 8. Provide handwheel operators for interior/exposed valves.
 9. Interior and Exterior Coating: AWWA C 550 fusion bonded epoxy coating, 8 mils minimum.
 10. Extension Stems: Provide for each valve buried 4 feet or deeper. Extension stem shall be 1-inch square solid steel and fitted over the valve operating nut. Set top of stem between 6-inches and 3 feet below finished grade.
- B. Plug Valves
1. Manufacturers
 - a. DeZurik, Series 100
 - b. Clow
 - c. or equal
 2. General: Non lubricated eccentric type valves resilient faced plugs rated for 175 psi working pressure. End connections shall be ANSI 125/150 lb standard.
 3. Valve Body: ASTM A126 Class B cast iron with 1/8-inch welded overlay seat of not less than 90% nickel. Seat area shall be raised with surface completely covered with weld to insure that plug face contacts only nickel.
 4. Plug: ASTM A126 Class B cast iron resilient face with neoprene or hycar, suitable for use with sewage. The interference between plug face and body seat, with plug in closed position shall be externally adjustable in the field with the valve in-line under pressure.
 5. Valve Seat Seals: Multiple V-ring type, externally adjustable and

repackable without removing bonnet or actuator from valve while under pressure.

6. Operator: Handwheel and Chain.

C. Ball Valves (2" and smaller):

1. Manufacturers
 - a. Hammond Valve Corporation
 - b. Watts Regulator
 - c. or equal
2. Two piece, full port design, ASTM B584 bronze body, ASTM B16 chrome plated brass ball, TFE reinforced seals, lever operated and rated for 600 psi WOG nonshock.

D. Combination Air Valves

1. Manufacturer
 - a. ARI, Model D-020
 - b. or equal.
2. General
 - a. The manufacturer shall demonstrate a minimum of (5) years experience in the manufacture of wastewater air valves. The valves shall be manufactured and tested in accordance with American Water Works Association Standard (AWWA) C512. Submittals for approval shall include dimensional drawing, parts list, and operation and maintenance manuals.
 - b. Furnish and install wastewater combination air valves as shown on the plans. All valves shall be suitable for pressures up to 230 psig.
 - c. The valve shall perform the functions of both wastewater air release and wastewater air vacuum valves and furnished as a single body.
 - d. Air valves shall be automatic float operated valves designed to exhaust air during the filling of a piping system and close upon liquid entry. The valve shall open during draining or if a negative pressure occurs. The valve shall also release

accumulated air from a piping system while the system is in operation and under pressure.

3. Connections

- a. Inlet size: 2-inches, male NPT
- b. Outlet size: 1-1/2 inch, male Kamlock fitting, polypropylene
- c. Shut-off valve: 2-inch, at bottom inlet, quarter-turn, full ported stainless steel.
- d. Drain valve: 1-inch, near bottom of valve body, quarter-turn, full port, stainless steel

4. Design

- a. Conical shaped body and float stem to keep operating mechanisms and orifice openings free from contact with liquid during purging of air. The valve seat shall provide complete shut off to the full valve pressure rating.
- b. Funnel shaped lower body.
- c. Valves shall have incorporate a full port orifice, a seal plug assembly, and an upper and lower float to provide a rolling resilient seal.
- d. The seal shall be a one-piece design and include a large orifice (1.25 square inches) and a small orifice (0.018 square inches) and each shall open or close as needed to allow release or intake of air as the demand on the system regulates.
- e. Valve shall be designed to intake or discharge a minimum of 100 SCFM of air with a 3.5-psi differential pressure.
- f. The valve shall be no more than 26-inches high.
- g. The entire valve assembly shall not weigh more than 35 pounds.

5. Materials – All materials of construction shall be corrosion resistant as follows:

- a. Valve body, cover, lower float, stem, washer, spring, nuts and bolts: 316 Stainless Steel.
- b. Upper float: Foamed polypropylene.
- c. O-rings: Buna-N.
- d. Seal plug assembly and base: Reinforced nylon
- e. The exterior of the valve shall not be coated.

2.03 PIPING SPECIALTIES AND APPURTENANCES

A. Steel Pipe Couplings:

1. Manufacturers
 - a. Dresser, Style 38
 - b. Smith-Blair, Style 411
 - c. or equal
2. Coupling shall consist of a middle ring, two (2) follower rings, two (2) gaskets and a sufficient number of bolts and nuts.
 - a. Middle Ring: ASTM A513 or ASTM A635 steel.
 - b. Followers: AISI C1012 or ASME SA 36.
 - c. Gasket: Resilient wedge-shaped suitable for use with raw sewage and sludge.
 - d. Bolts: AWWA C111/ANSI A21.11.

B. Flanged Adapters: Use for joining plain-end pipe to flanged fittings.

1. Manufacturers
 - a. Dresser, Style 127
 - b. Smith-Blair, Style 912
 - c. or equal
2. ASTM A-126 Class B, cast-iron. Flanges shall mate with standard ANSI/AWWA C207/B16.1 and B16.5 flanges of same nominal size.

C. Pipe to Wall Penetration Closures: Seals shall be modular mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with stainless steel bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and the wall opening. The seal shall be constructed so as to provide electric insulation between the pipe and wall to reduce the occurrence of cathodic reaction between the two members. Wall penetration closures shall be "Link-Seal" as manufactured by Thunderline Corp., or equal.

D. Floor Drains

1. Manufacturers
 - a. Wade
 - b. Smith Mfg. 6
 - c. or equal
 2. Fittings
 - a. Cast Iron
 - b. ANSI Load Class
- E. Wall Hydrant:
1. Manufacturers
 - a. Watts FHB Series
 - b. Merrill MF Series
 - c. or equal
 2. Frost-proof, automatically draining type with hose connection and vacuum breaker backflow preventer, heavy brass or bronze construction
- F. Hose Bibb:
1. Manufacturers
 - a. Hammond Valve
 - b. Nibco
 - c. or equal
 2. Bronze body, heavy duty pattern, iron tee handle, Buna-N seats, ¾" NPT inlet, ¾" hose outlet
- G. Electric Instantaneous Water Heater: Heater shall have an adjustable heat setting selector. Heater shall be 208 volt at ___ kilowatts. Heater shall be constructed of two (2) copper immersion heating elements with a solid copper heat exchanger, all contained within a UL approved ABS plastic housing. Heater shall be Powerstream Model RP1 or equivalent.
- H. Service Sink/Faucet
1. Manufacturers

- a. American Standard
 - b. or equal
2. Sink: Acid resistant, enameled, cast iron with hanger and rim guard.
3. Faucet: Rough chrome finish with vacuum breaker and renewable valves and seats.

2.04 PIPE ANCHORAGE AND SUPPORT

A. Buried Lines Under Pressure

1. CONTRACTOR has option of any of the means specified below. Length of restraint as shown on schedule on drawings.
 - a. Concrete Thrust Blocks and Tie Rods: Details as shown on drawings. Concrete shall be as specified in Section 03300 - Cast-In-Place Concrete, 3,000 psi compressive strength (at 28 days). Tie rods shall be constructed of suitable metal. Metal harness of tie rods shall be galvanized or otherwise rust proofed and shall be painted with bituminous coating after installation.
 - b. Megalug Retainer Glands: Mechanical joint restraint consisting of follower gland which when actuated imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. ASTM A 536-80 ductile iron follower gland of dimensions such that it can be used with AWWA C153 mechanical joints. Restraining devices shall be of ductile iron, heat treated to a minimum hardness of 370 BHN. Twist-off nuts shall be used to insure proper actuating of the restraint device. Restraint device shall have a 250 psi minimum working pressure with 2:1 minimum safety factor. Megalug retainer gland equivalent to EBAA Iron, Inc.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Carefully examine each section of pipe and each pipe fitting before laying in conformance with the inspection requirements of the appropriate referenced standard.
- B. Remove rejected pipe from the Project.

3.02 PREPARATION

- A. Clean piping interior and mating surfaces of bell, spigot and gasket before laying. Maintain clean until completed work is accepted.
- B. Touch-up chipped, cracked, or abraded surfaces and finished joints with two coats of the particular coating material.
- C. Perform trenching for sewer pipe and place pipe bedding as specified in Section 02221 - Trenching, Backfilling and Compacting and as indicated on the Drawings.
- D. Dig bell holes sufficiently large to permit proper joint making and to insure pipe is firmly bedded full length of its barrel.
- E. Excavate trenches in rock at least twenty-five (25) feet in advance of pipe laying. Protect pipe ends if blasting is allowed.

3.03 LAYING PIPE

- A. General Requirements:
 - 1. Lay pipe proceeding upgrade true to line and grades given. Lay bell and spigot pipe with bell end upgrade unless shown otherwise on the drawings or directed by the ENGINEER.
 - 2. Exercise care to insure that each length abuts against the next in such manner that no shoulder or unevenness of any kind occurs along inside bottom half of pipe line.
 - 3. Center spigot end in bell or socket end of previously laid pipe, shove tight and secure.
 - 4. No wedging or blocking permitted in laying pipe unless by written order of ENGINEER.
 - 5. Before joints are made, bed each section of pipe full length of barrel with recesses excavated so pipe invert forms continuous grade with invert of pipe previously laid. Do not bring succeeding pipe into position until the preceding length is embedded and securely in place.
 - 6. Walking or working on completed pipe line, except as necessary in tamping and backfilling, shall not be permitted until trench is backfilled one-foot deep over top of pipes.

7. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying.
8. Take up and replace with new, such in-place pipe sections found to be defective.
9. Take necessary precautions to prevent newly laid pipe from floating as a result water accumulation in the trench; or the collapse of the pipe line from any cause. Restore or replace pipe as necessary at CONTRACTOR's expense.
10. Bed pipe using materials specified in Section 02221 - Trenching, Backfilling and Compacting and as indicated on the Drawings.
11. At the close of each day's work, and at such other times when pipe is not being laid, protect open end of pipe with a close fitting stopper.
12. Cut pipe using only equipment specifically designed for that purpose such as an abrasive wheel, rotary wheel cutter, a guillotine pipe saw or a milling wheel saw. The use of chisels or hand saws will not be permitted. Grind smooth cut ends and rough edges. Bevel slightly, cut end for push-on connections.
13. Where cutting of pipe is necessary, minimum laying length shall be five (5) feet.

B. Specific Requirements:

1. Install plastic pipe and fittings, and assemble joints according to ASTM D 2321 for Class 1 bedding material.
2. Install ductile iron pipe and fittings, and assemble joints according to AWWA C600 requirements.

C. Joints:

1. Make pipe and fitting joints according to pipe manufacturer's specifications and to specifications previously specified for pipe.
2. Make joints watertight. Immediately repair detected leaks and defects. Methods of repair subject to ENGINEER's approval.

D. Alignment and Grade:

1. Lay and maintain all pipe at the required lines and grades as shown on the Drawings. Place wyes, other fittings, and valves at the required locations with joints centered, spigots forced home, and all valve stems plumb. Do not deviate from the required line and grade, except with the approval of the ENGINEER.
 2. Deflect pipe joints for pressure lines where indicated on the Drawings. Deflections shall not exceed $\frac{1}{2}$ pipe manufacturer's recommended maximum allowable deflection unless approved otherwise by ENGINEER.
 3. Do not change grade or alignment without ENGINEER's approval.
- E. Drop Connections: Make drop connections where indicated on the Drawings or as required by the ENGINEER. Construct drop connection according to Details shown on Drawings.
- F. Connections to Existing Manholes or Structures: As specified in Section 02601 - Manholes.

3.04 COLOR CODING AND PIPING IDENTIFICATIONS

- A. In order to facilitate identification, all exposed interior piping shall be identified and color coded as specified in Section 09800.

3.05 THRUST RESTRAINTS

- A. General: Provide thrust restraint at all plugs, caps, tees, and bends (both horizontal and vertical) on pipe lines 4 inches and larger.
- B. Concrete Reaction Backing: Place concrete reaction backing between undisturbed solid ground and the fitting to be anchored. The backing unless otherwise shown or directed, shall be located as to contain the resultant thrust force and so that the pipe and fitting joints will be accessible for repair.
- C. Install megalug retainer gland according to manufacturer's instructions.
- D. Temporary Thrust Restraint: Provide temporary thrust restraint at temporary caps or plugs. Submit details of temporary restraint to the ENGINEER for approval.

3.06 FLUSHING OF LINES

- A. Prior to commencing any line testing, thoroughly flush all newly installed lines to remove dirt rocks and other construction debris that may be present.

3.07 FIELD QUALITY CONTROL

- A. General Requirements: Conduct tests specified herein so that each pipe line installed in the Project is tested to the ENGINEER's satisfaction.
1. Provide tools, materials (including water), apparatus and instruments necessary for pipe line testing.
 2. Conduct tests in the presence of and to the satisfaction of the ENGINEER.
- B. Mandrel Test (for Gravity Lines): Deflection tests shall be performed on all plastic sewer pipes. The tests shall be conducted after the sewer trench has been backfilled to the desired finish grade for a minimum of 30 days. Deflection tests shall be performed by pulling a rigid ball or pointed mandrel through the pipe without the aid of mechanical pulling devices. The ball or mandrel shall have a minimum diameter equal to 95% of the actual inside diameter of pipe. The maximum allowable deflection shall not exceed 5% of the pipe's internal diameter. The line shall be considered acceptable if the mandrel can progress through the line without binding. The time of test, method of testing, and equipment to be used for the test shall be subject to approval by Engineer. Obstructions encountered by the mandrel shall be repaired and pipeline section retested until satisfactory at no additional cost to Owner.
- C. Leakage Tests (for Gravity Lines):
1. Air Testing: The CONTRACTOR shall test each section of sewer between manholes and all laterals to the limit of this contract using low pressure air. Testing shall not be performed, until all backfilling has been completed. The CONTRACTOR may, at his option, test the section of sewer for his own purposes, prior to completion of backfilling; however, the requirements of this subsection shall not be deemed to be completed until the lines have been tested after the backfilling has been completed and trench settlement has been minimized.
 2. A minimum of two minutes shall be provided to allow equilibrium of the air temperature with pipe wall before test readings shall commence.
 3. The test pressure to be developed in the sewer and laterals shall be 5.0 psig. Pipe test shall be considered acceptable if there is no pressure drop during the test period.

4. If the above rates of leakage are exceeded, the CONTRACTOR shall determine source of leakage and make all necessary corrections and retest.
5. The CONTRACTOR shall submit to the ENGINEER for approval the detailed test procedure and list of test equipment he proposes to use prior to testing.

D. Infiltration (for Gravity Lines):

1. After the air testing described in the preceding paragraph has been completed by the CONTRACTOR, regardless of any indications of the test results made by the ENGINEER or the OWNER, the ENGINEER and the OWNER reserve the right to perform field investigations, prior to final written acceptance of each sewer run by the OWNER and/or during the maintenance period specified elsewhere in these Specifications, to establish the leakage of groundwater into the sewer and laterals constructed under this contract.
2. Should the leakage exceed 100 gallons per day per inch diameter per mile of pipe for any section, the CONTRACTOR shall, at the direction of the ENGINEER or OWNER, and at no cost to the OWNER, perform any additional testing or corrective work required to reduce the infiltration in each manhole run from those lines installed by the CONTRACTOR to less than 100 gallons per day per inch diameter per mile of pipe. This leakage applies to each manhole run separately and should not be construed to mean total leakage in the total system. The scope of this corrective work shall include, but not be limited to, cleaning, televising and testing the sewer and laterals to the limits installed by the CONTRACTOR, to include testing and grouting of joints, excavation and replacement of faulty or damaged portions of the work, and all final restoration.

E. Hydrostatic Testing (for Pressure Lines):

1. Leakage Test Requirements:
 - a. After the pipe has been installed as specified, all newly laid pipe, or any valved section thereof, shall be subjected to a pressure of 150 pounds per square inch, or 50% in excess of the normal working pressure, whichever is greater.
 - b. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary

to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

- c. No pipe installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula,

$$L = \frac{ND \sqrt{P}}{7400}$$

in which "L" equals the allowable leakage in gallons per hour; "N" is the number of joints in the length of pipelines tested; "D" is the nominal diameter of the pipe, in inches, and "P" is the average test pressure during the leakage test, in pounds per square inch gauge. (The allowable leakage according to the formula is equivalent to 11.6 gallons per 24 hours per mile of pipe per inch nominal diameter, for pipe in 18' lengths evaluated on a pressure basis of 150 psi.)

2. Duration of Test: The duration of the test under pressure shall be two hours.
3. Procedure: Each valved section shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to ENGINEER. The pump, pipe connections, and all necessary apparatus, including gauges, shall be furnished by CONTRACTOR. CONTRACTOR will make all taps into the pipe, and furnish all necessary assistance for conducting the tests.
4. Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants or blowoffs are not available at high places, CONTRACTOR shall make the necessary taps at points of highest elevation before the test is made and insert the plugs after the test has been completed, at no additional cost to OWNER.
5. Variation from Permissible Leakage: Should any test of pipe laid disclose leakage greater than that specified above, CONTRACTOR shall, at his own expense, locate, repair and replace the defective joints, pipe or fittings until the leakage is within the specified allowance.
6. Time for Making Test:

- a. Where any section of a main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least five days have elapsed after the concrete reaction backing was installed. If high early strength cement is used in the concrete reaction backing, the hydrostatic pressure test shall not be made until at least two days have elapsed.
- b. ENGINEER shall be present during the operating of valves required to fill mains for pressure and leakage test.
- c. CONTRACTOR shall advise ENGINEER of any pressure test and leakage test at least 48 hours in advance. No testing will be authorized unless air temperature is 35 degrees or higher.
- d. The pressure and leakage tests shall be witnessed by ENGINEER.
- e. CONTRACTOR shall furnish laboratory calibrated test gauges and measuring devices for the leakage test.
- f. The section under test shall be brought back to test pressure at one-half hour intervals during the testing. ENGINEER will record both the makeup water amount and pressure at each one-half hour repressurization.

F. Alignment Test for Pressure Lines (for Pressure Lines):

1. Prior to backfilling of pressure lines, the joint alignment shall be inspected to assure the maximum deflection present in each joint does not exceed the manufacturer's recommendations.
2. Pressure lines which are a portion of a pump discharge system shall be inspected to assure the line is installed at a constant or increasing grade so as to eliminate the possibility for air accumulation at an intermediate high point.
3. Any and all defects shall be corrected by CONTRACTOR at no additional cost to OWNER and to the satisfaction of ENGINEER prior to backfilling. This shall be completed before the work shall proceed and before acceptance of and/or payment shall be made.

G. Acceptance: Observation of successful testing of manholes, sewers or force

mains by the ENGINEER does not constitute acceptance of the system or any portion thereof. Upon completion of any determined portion of a total system, and successful testing thereof, the ENGINEER may recommend final acceptance to the OWNER.

3.08 PIPING SCHEDULE

- A. CONTRACTOR shall construct pipe lines using the following materials of construction unless noted otherwise on Drawings. Where more than one material is indicated, CONTRACTOR shall have the options.

Description	Pipe Material	Joint Type
Sewer Mains	PVC SDR 35	Push-on
Sewer Mains (for areas <100 ft from wells and where directed by ENGINEER)	DIP	Mechanical Joint
Laterals	PVC SDR 35	Push-on
4" to 10" Forcemain	DR-14 Or DIP (Exposed) HDPE DR 13.5 (Below Grade)	Push-on Mechanical Joint Butt Fusion
1-1/2" & 2" Low Pressure Sewer	PVC SDR-21	Push-on

END OF SECTION

SECTION 02713 - WATER SYSTEM**PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes: Provision for water main pipe, fittings, valves, and appurtenances.
- B. Related Sections:
 - 1. Trenching, Backfilling and Compacting: Section 02221.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A21.10, Gray-Iron and Ductile-Iron Fittings, 3 inch through 48 inch, for Water and Other Liquids.
 - 2. ANSI A21.11, Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
 - 3. ANSI A21.50, Thickness Design of Ductile-Iron Pipe.
 - 4. ANSI A21.51, Ductile-Iron, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
 - 5. ANSI A21.53, Ductile-Iron Compact Fittings, 3 In. Through 24 In. (76 mm Through 610 mm) and 54 In. Through 64 In. (1,400 mm Through 1,600 mm) for Water Service.
 - 6. ANSI B16.26, Cast Copper Alloy Fittings for Flared Copper Tube.
 - 7. ANSI/NSF Standard 61 Drinking Water System Components.
- B. American Society for Testing and Materials:
 - 1. ASTM A123, Zinc (Hot-Galvanized) Coating on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips.
 - 2. ASTM A139, Electric-Fusion (Arc)-Welded Steel Pipe (Sizes 4 inch and over).
 - 3. ASTM A153, Zinc Coating (Hot Dip) on Iron or Steel Hardware.
 - 4. ASTM A242, Standard Specification for High Strength Low-Alloy Structural Steel.
 - 5. ASTM A536, Standard Specification for Ductile Iron Castings.
 - 6. ASTM B88, Standard Specification for Seamless Copper Water Tube.
 - 7. ASTM B633, Electrodeposited Coatings of Zinc on Steel.
 - 8. ASTM C2737, Standard Specification for Polyethylene (PE) Plastic Tubing.
- C. American Water Works Association:
 - 1. AWWA C104, Cement-Mortar Lining for Ductile Iron and Gray-Iron Pipe and Fittings for Water.
 - 2. AWWA C105, Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.

3. AWWA C110, Gray-Iron and Ductile-Iron Fittings, 3 inch through 48 inch, for Water and Other Liquids.
4. AWWA C111, Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
5. AWWA C150, Thickness Design of Ductile-Iron Pipe.
6. AWWA C151, Ductile-Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
7. AWWA C153, Ductile-Iron Compact Fittings, 3 In. Through 24 In. (76 mm Through 610 mm) and 54 In. Through 64 In. (1,400 mm Through 1,600 mm) for Water Service.
8. AWWA C502, Dry-Barrel Fire Hydrants.
9. AWWA C504, Standard for Rubber-Seated Butterfly Valves.
10. AWWA C509, Resilient-Seated Gate Valves, 3 inch through 12 inch NPS - for Water and Sewage Systems.
11. AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
12. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch Through 12 inch, for Water Distribution.

1.03 SUBMITTALS

- A. Shop Drawings and Product Data: Submit Shop Drawings, Catalog Cuts or other data for products furnished in accordance with Section 01300.
- B. Certificates:
 1. Certified records or reports of results of shop tests, to contain a sworn statement that shop tests were made as specified.
 2. Manufacturer's affidavit stating that products furnished comply with applicable provisions of referenced standards and modifications described in this Section.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle and store pipe materials and other specified products as recommended by respective manufacturers and supplemented in this Section, to prevent damage and defects.

1.05 PROJECT CONDITIONS

- A. Inspection:
 1. Items of material furnished under this Section will be inspected prior to installation.

B. Environmental Requirements:

1. Keep trenches dewatered while installing pipe until required pipe joints are made and trench backfilled above water table.
2. Under no circumstances lay pipe in water or on bedding containing frost.
3. Do not lay pipe when weather conditions are unsuitable, as determined by Water Company, for pipe laying work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Ductile Iron Pipe (DIP):

1. Pipe: Manufactured to conform to AWWA C151, latest edition.
2. Wall Thickness: Determined in accordance with AWWA C150 (ANSI A21.50), latest edition. Minimum wall thickness as follows:

Pipe Diameter Inches	Wall Thickness Inches	Thickness Class Designation
4	54	0.35
6	54	0.37
8	54	0.39
10	53	0.38
12	53	0.40
14	52	0.39
16	52	0.40
18	52	0.41
20	52	0.42
24	52	0.44
30	52	0.47

Note: The Water Company reserves the right to require a higher thickness classification where necessary.

3. Joints:

- a. Provide push-on, mechanical, or restrained joints for pipe installed underground. Areas where restrained joints are required are indicated on Drawings.

- b. Push-on, restrained, and mechanical joints to conform with applicable provisions of AWWA C111.
 4. Pipe Lining: Cement mortar lined in accordance with AWWA C104, double thickness, and asphaltic seal coated in accordance with Section 4-11, Seal Coat, of AWWA C104. Provide NSF 61 approved seal coatings.
 5. Outside Pipe Coatings: Asphaltic coating in accordance with Section 51-8, Coatings and Linings, AWWA C151.
 6. Manufacturers:
 - a. U.S. Pipe.
 - b. American.
 - c. Clow.
 - d. Griffin.
 - e. Atlantic States.
 - f. Or Approved Equal.
- B. Fittings:
 1. Gray iron or ductile iron conforming with applicable provisions of AWWA C110 or ductile iron compact fittings conforming to AWWA C153. Minimum working pressure rated at 250 psi.
 2. Fittings to be mechanical or restrained joint conforming with applicable provisions of AWWA C111.
 3. Provide ductile iron long sleeves for tie-ins or when joining cut new pipe. Mechanical couplings are not an acceptable substitute for ductile iron long sleeves.
 4. Fitting Lining: Cement mortar lined in accordance with AWWA C104, double thickness, and bituminous seal coated in accordance with Section 4-12, Seal Coat, of AWWA C104. Seal coatings NSF 61 approved.
 5. Fitting Coatings: Standard bituminous coating in accordance with Section 51-8, Coatings and Linings, AWWA C151.
- C. Joint Material for Ductile Iron Pipe or Fittings:
 1. Push-on Joints:
 - a. Ductile Iron Pipe: Conforming to requirements of AWWA C111.
 2. Mechanical Joints:
 - a. Ductile Iron Pipe and Fittings: Conforming to requirements of AWWA C111.
 - b. Provide mechanical joints with wedge action retainer glands.
 3. Flanged Adapter: Restrained flange adapter constructed of ductile iron conforming to ASTM A536 and flange bolt circles compatible with ANSI/AWWA C115/A21.15.
 1. Manufacturer:
 - a. EBAA Iron Sales Inc.; Series 2100 Megaflange.
 4. Tied Joint Restraint System for Ductile Iron Pipe:
 - a. Tied joints may be used to facilitate installation of pipe. Tied joints will not be accepted as only restraint on a joint unless specifically called for on

- Drawings and will not be accepted in lieu of restrained joints as specified below.
- b. Tied joint restraint system for ductile iron pipe and fittings (not including restrained joint pipe as specified elsewhere or retainer glands) consist of tie nuts, L-shaped tie bolts, retainer clamps, plug bars, tie rods and appurtenances.
 - c. Provide joint restraint products constructed of heat treated, corrosion resistant Cor-Ten steel meeting chemical and physical properties of ASTM A242 and be zinc plated or galvanized in accordance with ASTM A123, ASTM A153, or ASTM B633.
 - d. Exact size and type of installation as indicated on Drawings or as submitted to Water Company for approval.
 - e. Install joint restraint system in accordance with manufacturer's instructions. Torque nuts on mating threaded fasteners to 75 to 90 foot pounds for 3/4 inch nut.
 - f. Manufacturers:
 - 1) Star National Products.
5. Ductile Iron Pipe Restrained Joints: Conforming to applicable provisions of ANSI A21.10 and A21.11.
- a. Manufacturers:
 - 1) United States Pipe & Foundry Company, TR Flex restrained joint, 4 inches to 54 inches.
 - 2) Clow Corporation, Super-Lock restrained joint.
 - 3) American Cast Iron Pipe Company, Flex-Ring restrained joint, 4 inches to 36 inches; Lok-Ring restrained joint, 42 inches and larger.
 - 4) Griffin Pipe Products Co., Snap Lok restrained joint pipe.
 - b. Provide restrained fittings with identical joints as restrained joint pipe in restrained areas.
 - c. Valves with mechanical joints in restrained areas to be provided with adaptor pieces with the spigot ends modified to provide a restrained joint, using a welded ring and a second follower gland by restrained bell or restrained spigot ends similar to American MJ Coupled Joint. (Pipe supplier to submit detailed sketch of proposed restraining system for the Water Company's approval).
6. Wedge Action Retainer Glands:
- a. Provide retainer glands for use on mechanical joints on fittings and valves 24 inches or less. Use fully restrained type joints on fittings and valves greater than 24 inches. Retainer glands on fittings and valves greater than 24 inches not acceptable.
 - b. Retainer glands not acceptable in lieu of restrained joints.
 - c. Mechanical joint retainer glands cast from ASTM A536, Grade 65-45-12 ductile iron. Wedging mechanism manufactured of ductile iron, heat treated to a hardness of 370 BHN minimum. Provide retainer glands with dimensions that can be used with standardized mechanical joint bell and tee head bolts conforming to requirements of AWWA C111 and AWWA C153. Wedge action screws incorporate twist off nuts in design to ensure proper

- torque. Provide mechanical joint restraining device for water working pressure rating of 250 psi minimum with a safety factor of at least 2:1.
- d. Install mechanical joint retainer glands in accordance with manufacturer's recommendations. Apply torque to T- bolts in accordance with manufacturer's recommendations. Tighten torque limiting twist off nuts in alternate manner and clockwise direction. Apply joint deflection before T-bolts are torqued. Where retainer glands are used, limit joint deflection to 2-1/2 degrees maximum.
 - e. Provide retainer glands designed to prevent joint separation under following pressure ratings:

Size (Inches)	Pressure Rating (psi)
6	350
8	350
10	350
12	350
16	350
20	250
24	250

- f. Manufacturer:
 - 1) EBAA Iron, Inc., Series 1100 (Megalug).
 - 2) Ford Meter Box Co., Inc.; Series 1400 (Uni-Flange).
 - 3) Or Approved Equal.
- 7 Restraining Gasket for Push-On Pipe, Fittings and Valve Joints (For pipe installed in casing pipe: Stainless steel locking segments vulcanized into a gasket to prevent joint separation for operating pressures up to 250 psi based on performance requirements of ANSI/AWWA C111/A21.11.
 - a. Manufacturers:
 - 1) U.S. Pipe; Field LokGasket.
 - 2) American; Fast Grip Gasket.
 - 3) Or Approved Equal.

D. Valves:

- 1. Gate Valves: 3 through 12 inches in size to be iron body, resilient-seated nut operated, non-rising stem, inside screw gate valves suitable for buried service. Design valves for an operating pressure of 200 psi. Test pressures to 400 p.s.i. Design valves to operate in vertical position.

- a. Shop Drawing: Furnish Shop Drawings from manufacturer showing principal dimensions, construction details, and materials used for valve parts.
 - b. Size and Quantity: As indicated on Drawings.
 - c. Record of Tests: Furnish test records in accordance with AWWA C509 and Section 6.1.
 - d. Valve Ends: Mechanical joint in accordance with AWWA C111 with wedge action mechanical joint retainer glands, except in restrained area.
 - e. Stem Seal: Use Double O ring stem seals.
 - f. Operating Nuts and Direction of Opening: Square operating nuts conforming to AWWA C509. Valves to open Left.
 - g. Manufacturers:
 - 1) American Flow Control.
 - 2) U.S. Pipe.
 - 3) Or Approved Equal.
2. Butterfly Valves: Provide valves and operators conforming to AWWA C504, Rubber-Seated Butterfly Valves, except as modified in this Section.
- a. Construct valve disc from cast iron or ductile iron.
 - b. Valve Seats: New natural or synthetic rubber, recess mounted, bonded or mechanically secured to valve body or disc. If seats are recess mounted on valve disc, furnish as mechanically received with stainless steel retainers and stainless steel screws. Also when seats are recess mounted on discs, furnish stainless steel body seat rings, recessed and bonded into valve body. When seat is in body, furnish cast iron disc with stainless steel seating edge or corrosion resistant 80 percent nickel/20 percent chrome seating edge.
 - c. Provide stuffing boxes or "O" ring where valve shaft extends through valve body.
 - d. Valve Shaft: Stainless steel or monel, straight through or two piece.
 - e. Shaft Seals: Self compensating V-type packing.
 - f. Shaft Bearings: Self lubricating sleeve type. Provide adequate thrust bearings to keep disc centered regardless of valve position or have center thrust surfaces integral to valve disc.
 - g. Provide valves with mechanical joint ends and wedge action mechanical joint retainer glands, except in restrained areas.
 - h. Design valves to operate under a system pressure of 150 psi and maximum velocity of 8 ft./sec.
 - i. Operators:
 - 1) Nut operated and suitable for buried service. Provide each operator with ground level position indicator, Pratt Diviner, or equal.
 - 2) Provide nut operators of worm gear or lead screw type, self-locking and designed to hold valve in intermediate position between fully open and fully closed without creeping or fluttering. Provide operators with mechanical stop-limiting devices to prevent overtravel of disc in open and closed position. Operators to be fully enclosed and designed to produce specified torque with a maximum input of 150 pounds on operating nut. Operator components to withstand an input of 300 foot-

- pounds at extreme operator position without damage. Design operators in accordance with AWWA C504. Valves to open Left.
- j. Manufacturers:
 - 1) Henry Pratt
 - 2) DeZurik
 - 3) Or Approved Equal
 - 3. Combination Air Valve: Air release valve portion functions to vent air accumulating at high points in water main. Air/vacuum valve portion exhausts larger quantities of air present in system during filling of water main and allows air to re-enter main during draining of pipe.
 - a. Construction:
 - 1) Cast iron body and cover.
 - 2) Stainless steel float and parts.
 - 3) Buna-N seat.
 - b. Air Release Orifice Size: 3/32 inch.
 - c. Inlet Size: 2 inch.
 - d. Maximum Working Pressure: 150 psi.
 - e. Size and Quantity: As indicated on Drawings.
 - f. Manufacturers:
 - 1) Val-Matic Valve and Manufacturing Corp.
 - 2) APCO Valve and Primer Corp.
 - 3) G. A. Industries, Inc.
 - 4. Air Release Valves: Provide air release valves at the locations indicated on the Drawings. Provide air release valves with cast-iron body and cover, stainless steel float, stainless steel lever mechanism, and stainless steel trim with Buna-N-seat.
 - a. Inlet Size: 1 inch.
 - b. Maximum Working Pressure: 150 psi.
 - c. Manufacturers:
 - 1) Val-Matic, Model 38.
 - 2) APCO.
 - 3) G.A. Industries.
 - 4) Or Approved Equal.
 - 5. Pressure Reducing Valves: Pressure Regulating Valves 2" and smaller shall be diaphragm-type with cast-bronze body and galvanized iron strainer.
 - a. Manufacturer:
 - 1) Mueller Co.
 - 2) A. W. Cash Valve Mfg., Corp.
 - 3) Watson McDaniel Co.
 - 4) Watts Regulator Co.
 - 5) Or approved equal.
 - b. Pressure Reducing Valves 2-1/2" and larger shall be of a design and by a manufacturer approved by the Water Company for the particular installation.
 - 6. Tapping Sleeves and Valves: Verify type of existing pipe and outside diameter of pipe where installing tapping sleeve.

- a. Tapping Sleeves: Cast-iron with mechanical joint ends. Provide sleeves in two halves that can be assembled and bolted around main. Extend gaskets entire length of sleeve to form a watertight joint when side bolts are properly tightened.
 - b. Tapping Valve: Conforming to applicable requirements of AWWA C509 and to subparagraph 1. above. Provide tapping valves with flanged inlets and mechanical joint outlets.
 - c. Shop Drawing: Furnish Shop Drawings from manufacturer showing principal dimensions, construction details and materials used for parts of tapping sleeves and valves.
 - d. Size and Quantity: As indicated on Drawings.
 - e. Manufacturers:
 - 1) Kennedy Valve.
 - 2) American-Darling.
 - 3) Mueller Company.
 - 4) A. P. Smith.
 - 5) Or Approved Equal.
- E. Line Stop:
- 1. General: Line stop and associated materials and equipment are part of a specialized system required to stop flow within existing water pipelines. Furnish, install (with Contractor's assistance) and operate by line stop specialist, materials and equipment specified. After connection work is completed, line stop materials and equipment will be retained by line stop specialist, except for tapping sleeve and retainer plug to remain installed.
 - 2. Split Tapping Sleeve: Steel split mechanical joint type sleeve with "O" ring and end seals structurally suitable for tapping and line stop operations.
 - a. Sleeve Size: To be determined.
 - b. Design split sleeve for longitudinal welding.
 - c. Sleeve Coating: Bitumastic on outside and epoxy lined on inside with NSF 61 approved paint.
 - 3. Tapping and Line Stop Valve: Gate valve type adapted for tapping and line stop operations.
 - 4. Tapping and Line Stop Machines: Tapping and line stop machine suitable for tapping cast iron or ductile iron pipe and installing folding head plugger.
 - 5. Line Stops: Folding head type.
 - 6. Watertight Split Tapping Sleeve Restrained Plug: Developed by line stop specialist and designed to be watertight and withstand internal water pressure of 70 feet. Line and coat watertight tapping sleeve restrained plug as specified for split sleeves.
 - 7. Line Stop Specialist:
 - a. Kerr Engineered Sales Company, 5940 Baum Square, Pittsburgh, PA 15206-3893.
 - b. International Piping Services Company, P.O. Box 388, Hainesport, NJ 08036.
 - c. Hydra-Stop, Inc., 12601 South Homan Ave., Blue Island, IL 60406.

d. Approved equal.

F. Fire Hydrants:

1. Design: Compression type, traffic type with breakable safety flange and stem coupling. Conform to requirements of AWWA C502.
 - a. Hydrant Seat Opening: 5 inch.
 - b. Inlet: 6 inch mechanical joint with wedge action retainer gland.
 - c. Pumper Nozzle, Hose Nozzle, and Operating Nut.
 - 1) The two and one-half inch outlets (3 inch O.D.) shall have 8 threads per inch, and the 4-1/2-inch outlet 5-3/4 inch O.D.) shall have 4 threads per inch.
 - 2) See hydrant detail on Drawings.
2. Painting: Exposed portion to be painted a color as selected by Water Company.
3. Manufacturer:
 - a. American Darling.

G. Extension Stems. Each underground valve whose operating nut is deeper than 4 feet shall be equipped with an extension stem that is 1 inch square solid steel and fitted over the valve operating nut. The stem shall have a 2 inch square top operating nut and a spacer or spyder. Each extension stem top shall be set in the range from 3 feet to 6 inches below ground surface and shall not interfere with the valve box cover.

H. Blow-Off:

1. Blow-off shall consist of a flushing hydrant with a close combination bend and ball valve in a 6-inch I.D. Roadway Box with removable cover.
2. Flushing hydrant shall be of automatic freeze-proof design with weep hole installed within a 2-inch ball valve. Valve will be 600 lb. wog bronze body with chrome plated brass ball and teflon seals.
3. Hydrant barrel must be of black iron pipe. Exterior shall receive 4 mil thickness of electrostatically applied Sherwin-Williams Fast Dry Acrylic Enamel, catalyzed with Polane for durability. All hydrants to be painted blue. Overall length of hydrant will vary, according to the depths of water systems. A brass hose connection, 2-1/2" NSFT with attached cap and chain, shall be provided for convenience in flushing.
4. Operating device to be of key type design, with permanent attachment to the valve stem. Valve stem must be full length of the hydrant barrel with permanent attachment to the valve. Hydrant must have provision for lock up to prevent tampering.
5. Flushing Hydrant to be "SLIM LINE 2" FLUSHING HYDRANT as manufactured by GIL Industries, Inc., Pensacola, Florida, or approved equal.
6. Roadway box must have an inside diameter of 6 inches and a minimum length of 18 inches. Box shall be constructed of cast or ductile iron and be capable of withstanding highway loads. Box shall have a removable cover marked WATER. Box shall be hot coated inside and out with a tar or asphalt compound. Box shall be capable of receiving increment rings to raise the box in the future.

- I. Valve Boxes: Provide cast iron valve boxes of two piece or Buffalo Type for valves up to 12 inch and of three piece for valves up through 20 inch buried in ground. Valve box design of adjustable two section screw type telescoping column or three section with separate base, column inside diameter of 5-1/4 inches, and furnished with a cover marked WATER. Hot coat inside and out with tar or asphalt compound.
- J. Copper Tube: Conforming to requirements of ASTM B88, Type K.
- K. Fittings for Copper Tubing: Use compression type fittings for use with copper tubing installed underground, conforming to requirements of ANSI B16.26.
- L. Corporation Stops: Ford Meter Box Co. FB1000G, or approved equal.
- M. Curb Stops: Ford Meter Box Co., Inc., Series B44G, or approved equal.
- N. Curb Boxes: Buffalo type with a 2-1/4 inch or 2-1/2 inch shaft of required size. Provide Tyler 6500 Series, or approved equal.
- O. Service Saddle: Service saddles shall be Ford Meter Box Co. Type FC-101 with stainless steel band and epoxy coating.
- P. Casing Spacers: Support water mains inside steel casing pipe by use of casing spacers to prevent direct contact between water main and steel casing. Casing spacers also facilitate installation of pipe within casing, and limits movement of pipe within casing, both vertically and horizontally.
 - 1. Provide casing spacers of the following design type:
 - a. Bolt on style, T-304 stainless steel (14 gauge) shell and risers, lined with ribbed PVC extrusion, and ultra high molecular weight polymer insulating runners. All fasteners to be T-304 stainless steel.
 - 2. Acceptable Manufacturers:
 - a. PSI Pipeline Seal and Insulator, Inc.
 - b. Cascade Waterworks Mfg. Co.
 - c. APS Advance Products and Systems, Inc.
- Q. Meters: All services shall be metered. Meters to be supplied and installed by the Water Company and Water Company personnel. Meters shall be as described in Section 7 of the Water Company Rates, Rules and Regulations.
- R. Backflow Preventors: Backflow Preventors shall be installed wherever the present or future possibility of a cross connection exists. Backflow Preventors shall be as described in Section 7 of the Water Company Rates, Rules and Regulations.
- S. Corrosion Control: Water mains that cross pipelines which are now, or may be in the future cathodically protected are to be constructed using PVC pipe as specified herein. The PVC pipe shall extend a minimum distance of 20 feet from the crossing pipe on

each side. The PVC pipe shall be suitable for direct connection to cast iron or ductile iron piping, and shall conform to AWWA C900.

1. Acceptable Manufacturer:
 - a. Johns Manville; Blue Brute Thickwall Ring-Tite.
 - b. Or Approved Equal.

T. Pipeline Marker Posts: Furnish and install pipeline marker posts at locations indicated on Drawings. Paint steel posts with one coat of MAB Minit Dri Enamel, or approved equal, prior to setting posts over pipeline. Coat again after post is set in ground. Tack weld a 20 gage steel sign (6" by 6") at top of steel post with words as directed by the Water Company, (1/2" lettering) painted in black. Paint sign with one coat of MAB Minit Dri Enamel. Color for post and sign to be determined by Water Company.

U. Polyethylene Encasement: Provide LLDPE cross laminated polyethylene tubes or sheet per AWWA/ANSI C105/A21.5 on buried pipe, valves and appurtenances including service lines.

2.02 SOURCE QUALITY CONTROL

- A. Tests, Inspection:
1. Ductile Iron Pipe: Test in accordance with AWWA C151 (ANSI A21.51).
 2. Fittings: Test gray-iron and ductile-iron fittings in accordance with AWWA C110 (ANSI A21.10). and AWWA C153 (ANSI A21.53) Compact Fittings.
 3. Steel Pipe: Furnish manufacturers sworn statement that inspection and specified test have been made on steel pipe as required by ASTM A139 and results comply with requirements of that standard.

PART 3 - EXECUTION

3.01 RESPONSIBILITY FOR MATERIAL

- A. Carefully examine material for defects, and do not install material known to be defective.
- B. Replace material found defective in manufacture or damaged in transit or handling at no additional expense.
- C. Remove defective material from jobsite.

3.02 DEFECTIVE PIPE

- A. Water Company reserves right to reject defective pipe shipped to jobsite or stored on site. Water Company will examine pipe and determine if pipe is damaged prior to installation in trench. Failure of Water Company to detect damaged pipe does not relieve Contractor's total responsibility for pipe if it leaks or breaks after installation. Set defective pipe and fittings aside for final inspection by Water Company to

determine if corrective repairs can be made, or material rejected. Water Company will determine extent of repairs. Classify defective pipe as follows:

1. Damage to interior and exterior paint seal coats.
2. Damage to interior cement-mortar lining.
3. Insufficient cement-mortar lining thickness.
4. Poor quality interior paint seal coat.
5. Pipe out of round.
6. Damage pipe barrel area to point where pipe class thickness is reduced.
7. Denting or gouges in plain end of pipe.

3.03 HANDLING OF MATERIAL

A. Handling of Pipe and Fittings:

1. Unload, handle and store ductile iron pipe, fittings, valves and appurtenances in accordance with AWWA C600. If damage or coating abrasion occurs and is deemed repairable, repair as directed by Water Company, in accordance with manufacturers recommendations. If damage is not repairable in opinion of Water Company, reject pipe, fittings, valves or appurtenances, remove from Project site and replace at no additional expense.
2. Keep fittings and valves drained and stored before installation in a manner protecting them from damage due to freezing of trapped water in accordance with Section 01600.

3.04 CLEANING PIPE AND FITTINGS

- #### A.
- Clean and remove foreign matter from pipe, fittings and valves before placing in trench. Remove pipe and fittings if interior has been contaminated with oil, gasoline, kerosene or other material damaging to bituminous seal coat or cement-mortar lining and replace at no cost to Water Company. Should foreign material or contaminants be observed in previously installed pipe, cease work until foreign material or contaminated pipe is decontaminated or removed.
- #### B.
- Close open ends of pipe with a watertight plug when pipe laying is not in progress.

3.05 ALIGNMENT AND GRADE

- #### A.
- Lay and maintain pipe at required lines and grades as indicated on Drawings. Place fittings and valves at required locations with joints centered, spigots forced home, and valve stems plumb. Do not deviate from required line and grade, except with approval of Water Company.
- #### B. Joint Deflection:
1. Maximum allowable deflection at joints for push-on joint pipe as follows:

Size of Pipe	Deflection Angle	Maximum Deflection (18 ft. Length) (20 ft. Length)	
		9-1/2"	10-1/2"
Thru 12"	2-1/2°		

2. If curve is too sharp for allowable deflection, short lengths of pipe may be used upon approval of Water Company.
- C. Where underground conditions indicate a change of alignment or grade, make change only with written consent of Water Company. When a change in grade is indicated resulting in pipe having more cover than originally anticipated, carefully review class of pipe scheduled for installation at location to ensure it can withstand new loadings. If it cannot, replace with proper class of pipe, as directed by Water Company.
- D. Except at points indicated on Drawings, exercise particular care that no high points are established where air can accumulate. In event field conditions necessitate a change in pipe profile and, in opinion of Water Company, resulting change requires installation of an air valve and manhole, installation of the same shall be handled as follows. If Contractor requests a change in pipe profile to facilitate construction, and resulting change requires installation of an air valve and manhole at high points due to requested change, cost of furnishing and installing air valve and manhole is at Contractor's expense.

3.06 LAYING PIPE

- A. General Requirements: Use proper and suitable tools and appliances for proper and safe handling, lowering into trench and laying of pipes.
1. Do not lay pipe in a wet trench, on subgrade containing frost, and when trench conditions are unsuitable for pipe laying work. If efforts fail to obtain a stable dry trench bottom and Water Company determines trench bottom is unsuitable for trench foundation, he will order in writing type of stabilization to be constructed.
 2. Thoroughly clean pipes and fittings before installing and keep clean until acceptance of completed work.
 3. Lay pipe with bell ends facing in direction of laying, unless otherwise indicated on Drawings, or directed by Water Company.
 4. Exercise care to ensure each length abuts next effecting no shoulder or unevenness occurs in pipeline.
 5. No wedging or blocking permitted in laying pipe unless by written order of Water Company.
 6. Before joints are made, bed each section of pipe full length of barrel with recesses excavated so pipe invert forms continuous grade with invert of pipe previously laid. Do not bring succeeding pipe into position until preceding length is embedded and securely in place.
 7. Dig bell holes sufficiently large to permit proper joint making and to ensure pipe is firmly bedded full length of its barrel.

8. Walking or working on completed pipeline, except as required in tamping and backfilling, not permitted until trench is backfilled one foot deep over top of pipes.
 9. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying.
 10. Take up and replace with new, at no additional expense, in-place pipe sections found to be defective.
 11. Take necessary precautions to prevent floating of pipeline by accumulation of water in trench, or collapse of pipeline. Should floating or collapse occur, restore at no additional expense.
 12. Bedding materials and concrete work for pipe bedding as specified previously in Section 02221.
 13. Take every precaution to prevent foreign material from entering pipe while it is being placed in line. During laying operations, do not place debris, tools, clothing, or other materials in pipe.
 14. Close openings in pipeline with watertight plugs when pipe laying is stopped at close of day's work or for rest breaks, meal periods or other reasons.
 15. Place enough backfill over center sections of pipe to prevent floating.
 16. Place underground warning tape over pipeline as specified in Section 02221.
 17. Carry out cutting of pipe with an abrasive wheel, rotary wheel cutter, guillotine pipe saw, milling wheel saw or other equipment specifically designed for that purpose. Use of chisels or hand saws not permitted. Grind smooth cut ends and rough edges and for push-on connections, cut end should be beveled slightly.
- B. Joints. Exercise care when making each joint, and make in accordance with pipe supplier's specifications and in accordance with following instructions:
1. Ductile Iron Pipe:
 - a. Push-On Joints: Join pipe in accordance with AWWA C600, Section 3.4.1 or latest revision, and following.
 - 1) Assemble push-on joint to provide tight, flexible joints that safely permit movement caused by expansion and contraction due to temperature changes and by ground movement.
 - 2) Thoroughly clean inside of bell and outside of spigot end to remove oil, grit, excess coating and other foreign matter. Flex circular rubber gasket inward and insert in gasket recess of bell socket. Apply a thin film of gasket lubricant to either inside surface of gasket or spigot end of pipe or both. Gasket lubricant to be supplied by pipe manufacturer and approved by Water Company prior to its use.
 - 3) Enter spigot end of pipe into socket with care to keep joint from contacting ground. Complete joint by forcing plain end to bottom of socket with a forked tool or jack type tool or other device as may be approved by Water Company. Mark pipe that is not furnished with a depth mark before assembly to ensure spigot end is inserted to full depth of joint. File or ground field cut pipe lengths to resemble spigot end of pipe as manufactured. Complete assembly instructions are available from pipe manufacturer.

- b. Mechanical Joint: Furnish sworn statement that inspection and tests on parts of this type joint have been made and met as specified. Join in accordance with AWWA C600, Section 3.4.2., latest revision, and following:

- 1) Centrally locate spigot in bell. Thoroughly brush contact surfaces of rubber gasket seal with a wire brush just prior to assembly. Remove loose rust or foreign material and brush with soapy water prior to slipping gasket over spigot end and into bell. Normal range of bolt torques applied to standard cast iron bolts in joint are as follows:

Size Inches	Range of Torque Ft. - Lb.
5/8	40-60
3/4	60-90
1	70-100
1-1/4	90-120

- 2) Above torque loads may be applied with torque measuring or indicating wrenches. Torque wrenches may be used to check application of approximate torque loads applied by men trained to give an average pull on a definite length of regular socket wrench. Following lengths of wrenches should satisfactorily produce above range of torques when used by average man:

Size Inches	Length of Wrench Inches
5/8	8
3/4	10
1	12
1-1/4	14

- 3) When tightening bolts, it is essential that gland be brought up toward pipe flange evenly, maintaining equivalent distance between gland and face of flange at all points around socket. This may be done by partially tightening bottom bolt first, then top bolt, next bolts at either side, and last, remaining bolts. Repeat this cycle until bolts are within above range of torques. If effective sealing is not attained at maximum torque indicated above, disassemble and reassemble joint after thorough

cleaning. Avoid overstressing of bolts to compensate for poor installation practice.

- c. Retainer Glands: Install retainer glands as with mechanical joints, except after joint bolts are tightened, tighten restraining screws in retainer gland. Required torque range for retaining screws as specified by retainer gland manufacturer.
- d. Restrained Joints: Install in accordance with manufacturer's recommendations.

3.07 INSTALLATION OF POLYETHYLENE TUBING ON DUCTILE IRON PIPE.

- A. Install polyethylene tubing around ductile iron pipe and appurtenances. Prior to installation of first pipe and polyethylene tubing, arrange a meeting between a representative of pipe manufacturer, Water Company, and his supervisory personnel. Purpose of meeting is have representative of pipe manufacturer review, expound, and demonstrate following procedure for installing polyethylene tubing, answer questions, and observe installation of at least three lengths of ductile iron pipe with polyethylene tubing.
- B. Install polyethylene tubing in accordance with AWWA C105, method A, as described below:
 - 1. Raise a length of pipe at side of trench to a height of about 3 feet above ground level by means of hoisting equipment and a pipe sling or tongs. Using a precut length of polyethylene tubing (approximately 2 feet longer than length of pipe to be covered), slide polyethylene tubing over bell end of pipe. Inspect material for cuts. If there is a cut, Water Company will decide whether material can be repaired by taping Polyken No. 900, or Scotchrap No. 50, or whether material be replaced at no additional expense to Water Company. After material is approved or replaced, bunch polyethylene tubing near bell end of pipe.
 - 2. Lower pipe into trench. Affect joining of lowered length to previously laid pipe. Shallow bell holes at pipe joints facilitate overlapping of polyethylene tubing at pipe joints.
 - 3. Raise bell end of newly laid pipe clear of trench bottom. Pull polyethylene tubing along remainder of pipe length to spigot end of recently affected joint. Leave surplus bunched at bell end for subsequent covering of next joint.
 - a. Take care not to allow foreign material from getting between polyethylene tubing and pipe. If it does, completely remove foreign material before proceeding to next phase of installation.
 - 4. Cover joint by pulling polyethylene tubing from previously laid pipe over bell. Fold polyethylene tubing around spigot end of pipe being laid, and wrap with at least three circumferential turns of specified 2 inch wide plastic tape to hold polyethylene tube around spigot end.
 - 5. Pull polyethylene tubing on pipe being laid over polyethylene tubing already covering joint, as specified above. Overlap at least 1 foot. Neatly fold polyethylene tubing and hold it in place by at least three circumferential turns of specified 2 inch wide plastic adhesive tape.

6. To eliminate voids and pockets in loose polyethylene tube material covering pipe, neatly draw up excess material around pipe barrel, creating a close fit between pipe and material. Fold excess material into an overlap on top of pipe and hold it in place at approximately 3 foot to 5 foot intervals by means of pieces of specified plastic tape.
 7. Backfill around covered pipe in accordance with Section 02221. If a mechanical tamper cuts polyethylene material, remove backfill material, repair cut as approved by Water Company, and backfill trench again in 4 inch layers.
- C. Use above procedure for covering pipe bends. Ensure excess material is properly drawn up.
- D. Cover tees, valves and irregularly shaped appurtenances, in above manner, except split polyethylene tubing at a suitable length, and fold and tape resulting flat sheet around fitting or valve.

3.08 VALVE INSTALLATION

- A. Examination of Material: Prior to installation, inspect valves for direction of opening, freedom of operation, tightness of pressure containing bolting, cleanliness of valve ports and especially seating surfaces, handling damage and cracks. Correct defective valves or hold for inspection by Water Company.
- B. Installation: Set and join to pipe in manner specified in Article 3.06. Provide valves 12 inch and larger with crushed stone or concrete pad support so that pipe does not support weight of valve. Set truly vertical.
- C. Valve Protection: Provide valves with a valve box. Set top of valve box neatly to grade of surface of existing ground, unless directed otherwise by Water Company. Do not transfer shock or stress to valve, and center and plumb box over wrench nut of valve. Do not use valves to bring misaligned pipe into alignment during installation. Support pipe in manner to prevent stress on valve.

3.09 HYDRANT INSTALLATION

- A. Location: As indicated on Drawings or as directed by Water Company. Take care to locate hydrant, so that it is completely accessible, but minimizes possibility of damage from vehicles or injury to pedestrians. When placed behind curb, set hydrant barrel so that no portion of pumper or hose nozzle cap is less than 6 inches, nor more than 12 inches from gutter face of curb. When set in lawn space between curb and sidewalk, or between sidewalk and property line, maintain a minimum distance of 6 inches between sidewalk and hydrant caps.
- B. Installation: Install in accordance with details indicated on Drawings. Stand hydrant plumb with pumper nozzle facing curb and hose nozzles parallel to curb. Set nozzles

at least 12 inches above existing ground, unless otherwise directed by Water Company.

1. Connection: Connect to main with a 6 inch branch pipe controlled by an independent 6 inch gate valve.
2. Drainage: Provide at base of hydrant by placing coarse gravel or crushed stone, mixed with coarse sand, from bottom of trench to at least 6 inches above waste opening in hydrant, and to a distance of 1 foot around hydrant base.

3.10 THRUST RESTRAINT

- A. General: Provide all nonrestrained caps, tees, and bends (both horizontal and vertical) with thrust restraints as detailed on Drawings.
- B. Concrete Reaction Backing: Place concrete reaction backing between undisturbed solid ground and fitting to be anchored. Locate backing, unless otherwise shown or directed, to contain resultant thrust force and so that pipe and fitting joints are accessible for repair.
- C. Temporary Thrust Restraint: Provide for temporary thrust restraint at temporary caps or plugs. Submit details of temporary restraint to Water Company for approval.
- D. Metal Harnessing: At connections with existing water mains where there is a limit on time water main may be removed from service, use metal harnesses of anchor clamps, tie rods and straps; mechanical joints utilizing wedge action retainer glands; or restrained push-on joints in conjunction with concrete thrust blocks. Metal harnessing may not be used in lieu of concrete backing without approval of Water Company. Submit details of proposed installation to Water Company for approval. For pipe up to 12 inches in size, use a minimum of two 3/4 inch tie rods. For pipe 16 inch in size, four 3/4 inch tie rods are required and for 20 inch pipe, six 3/4 inch tie rods are required. Install retainer glands in accordance with instructions of particular manufacturer furnishing glands.
- E. Protection of Metal Harnessing: Protect tie rods, clamps and other components of dissimilar metal against corrosion by hand application of a bituminous coating or by encasement of entire assembly with 8 mil thick, loose polyethylene film in accordance with AWWA C105.

3.11 CONNECTIONS TO EXISTING WATER MAINS AND INTERRUPTIONS OF SERVICE

- A. Notification: Notify Water Company a minimum of 7 working days in advance of anticipated time for installing a connection to water system, or when necessary to close down a portion of existing system to carry out work. Under no circumstances are valves to be manipulated on existing water system, except under direct supervision of a representative of Water Company.

- B. Water Company's Restrictions: Water Company reserves right to designate day and time when existing water main may be removed from service. Water Company may require that this work be done at night or on a weekend. In addition, Water Company further reserves right to require that work on installation of connections between existing and new water mains, or in other areas where service to customers will be interrupted, be carried out continuously and expeditiously until water service is restored.
- C. Notification of Customers: Give adequate and timely notice to affected customers that construction will require interruption of service.
- D. Installation: In cases where connections to existing water system or other work require an interruption of water service, carefully plan work ahead in close coordination with Water Company. Obtain Water Company's approval of installation schedule and procedure before work is started, and procure necessary materials, tools and equipment before work is started. Make provision in prices bid for connections, and laying pipe adjacent to existing fittings, for adequate personnel to be available for continuous operations and payment of premium time. No additional or extra payment made for extra personnel and overtime for installation of connections, cutting and capping of existing water mains, or passing of existing fittings, whether or not Water Company directs that work be continuous, without interruption, and that this work be at night or on a Sunday.
- E. Installation of Tapping Sleeves and Valves: Use tapping machine and strictly follow manufacturers instructions. Submit procedure for approval prior to installing. Personnel performing tap to have been regularly engaged in installing taps of this size for at least 10 years and have at least 5 installations in successful operation for 5 years. Submit installation certificate in accordance with Section 01400.

3.12 FIELD QUALITY CONTROL

- A. Hydrostatic Pressure and Leakage Test: Give each water main each Part of Contract a hydrostatic pressure and leakage test in field. Conduct tests meeting approval of Water Company before each water main is accepted.
- B. Test in accordance with provisions of Section 01666, Testing of Water Mains, of these Specifications.

3.13 DISINFECTION OF WATER MAINS

- A. Disinfect and flush with water in accordance with provisions of Section 01656 - Disinfection of Water Mains.

END OF SECTION

SECTION 02937 – GRADING AND SEEDING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Work of this section includes, but is not limited to:

1. Preparation of subsoil
2. Placing topsoil
3. Seeding, mulching and fertilizer
4. Maintenance

1.02 RELATED SECTIONS

A. Section 01400 – Quality Control

1.03 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.04 SUBMITTALS

A. Certificates:

1. Prior to use or placement of material, submit certifications of material composition of the following for approval:
 - a. Fertilizer
 - b. Seed mixture(s)

1.05 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix; year of production, net weight, date of packaging, and location of packaging.

- B. Provide fertilizers and lime materials in containers showing percentage by weight of all components.

1.06 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide compositions.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle protects to site according to manufacturer's recommendations and instructions.
- B. Seed: Deliver seed fully tagged and in separate packages according to species or seed mix. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be accepted.
- C. Fertilizer: Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.08 PROJECT CONDITIONS

- A. Restore unpaved surfaces to a condition similar to that prior to excavation as specified and indicated on the Drawings

1.09 MAINTENANCE

- A. Maintain seeded area immediately after placement until grass is well established and in the opinion of the ENGINEER, exhibits a vigorous growing condition.

PART 2 - PRODUCTS

2.01 SEED MIXTURE

- A. Grass Seed: New crop seed furnished in sealed package with proof of correct mixture evidenced, age indicated, and compliance with applicable State regulations evidenced if required.
- A. Seed Mixture for Lawn Area (by Weight)
 - 1. Kentucky Blue Grass: 50%
 - 2. Creeping Red Fescue Grass: 30%
 - 3. Norles Perennial Rye: 20%

B. Seed Mixture for Meadow Areas (by Weight)

- | | | |
|----|----------------------|-----|
| 1. | Timothy: | 18% |
| 2. | Orchard Grass: | 46% |
| 3. | Redtop: | 18% |
| 4. | Kentucky Blue Grass: | 18% |

C. Embankments, 3:1 Slopes and Greater (by Weight)

- | | | |
|----|------------------|-----|
| 1. | Crownvetch: | 45% |
| 2. | Annual Ryegrass: | 55% |

D. Wetland Areas:

1. Provide seeding mixture for wetland areas consisting of herbaceous mixture of Kentucky 31 Tall Fescue, Birdsfoot Trefoil, and Red Top. Other commercially available wetland grass mixtures will be considered if submitted as substitute.

2.02 SOIL MATERIALS

- A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value satisfactory to sustain plant growth.
- B. To extent that material excavated from the site conforms to these requirements, such material may be used as topsoil. If onsite materials are insufficient, provide material meeting these requirements from offsite locations. All material to be used as topsoil shall be approved by ENGINEER. Tests required by ENGINEER to evaluate materials shall be responsibility of CONTRACTOR. Any offsite material required for completion of the Work shall be furnished by CONTRACTOR at no additional cost to OWNER.

2.03 ACCESSORIES

- A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.
- B. Fertilizer: Recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated in analysis.
- C. Agricultural Lime: Products containing calcium and magnesium compounds capable of neutralizing soil acidity and containing not less than 80% of total carbonates. Use liming materials meeting requirements of ASTM Designation C602.

- D. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.
- E. Erosion Fabric: Jute matting, open weave.
- F. Stakes: Softwood lumber, chisel pointed.
- G. String: Inorganic fiber.

2:04 TESTS

- A. Provide analysis of topsoil fill under provisions of Section 01400.
- B. Analyze to ascertain percentage of nitrogen, phosphorous, potash, soluble salt content, organic matter content, and pH value.
- C. Submit a sufficient number of 10-oz samples of topsoil proposed to provide representative results for material to be used. Forward samples to approved testing laboratory in sealed containers to prevent contamination. Provide three (3) copies of laboratory results indicating soil analysis and recommendations for soil amendments.

PART 3 – EXECUTION

3:01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of the Section.
- B. Remove surface rocks or other foreign objects exceeding 3-inches in greatest dimension. Dispose of such rocks and debris in a lawful manner off site.

3:02 PREPARATION OF SUBSOIL

- A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated sub-soil.
- C. Scarify subsoil to a depth of 3-inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil. Use equipment common to lawn work.

3:03 PLACING TOPSOIL

- A. Spread topsoil to a depth of 6-inches over area to be seeded. Rake until smooth.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.
- D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.
- E. Install edging at periphery of seeded areas in straight lines to consistent depth.

3:04 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions at a rate sufficient to supplement the topsoil as indicated by the laboratory tests.
- B. Apply after smooth raking of topsoil and prior to roller compaction.
- C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- D. Mix thoroughly into upper 2-inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3:05 SEEDING

- A. Sow seed mixtures when air current is low and not more than five (5) days after soil supplements have been applied. Sow seeds in two (2) applications using power or mechanical seeders. Sow one half of seed mixture in one direction over designated areas and remainder at right angles to first sowing. Rake in seed lightly. Seeding rates shall be as follows:
 - 1. Lawn Mixture: 5 lbs per 1,000 sq ft.
 - 2. Meadow Mixture: 5 lbs per 1,000 sq ft.
 - 3. Embankments: 1 lb per 1,000 sq ft.
 - 4. Wetlands: As recommended by manufacturer.
- B. Do not seed areas in excess of that which can be mulched on same day.

- C. Planting Season: April 1 – October 1.
- D. Do not sow immediately following rain, when ground is too dry, or during windy periods.
- E. Roll seeded area with roller not exceeding 120 lbs.
- F. Immediately following seeding and rolling, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.
- G. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4-inches of soil.

3:06 HYDROSEEDING

- A. In lieu of the seeding procedures outlined above, use of an approved hydroseeding procedure for lawn, meadow and crown vetch seeding is acceptable. Submit proposed procedure to ENGINEER for review and approval prior to initiation of the work.

3:07 SEED PROTECTION

- A. Identify seeded areas with stakes and string around area periphery. Set string height to 18 inches. Space stakes at 48-inches.
- B. Cover seeded slopes where grade is 4-inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.
- C. Lay fabric smoothly on surface, bury top end of each section in 6-inch deep excavated topsoil trench. Provide 12-inch overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.
- D. Secure outside edges and overlaps at 36-inch intervals with stakes.
- E. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
- F. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

3:08 MAINTENANCE

- A. Begin maintenance operations immediately after seeding and planting is performed; and continue throughout construction time and guarantee period. In general, maintenance includes weeding, applying mulch as needed, controlling insects and

diseases, grass cutting, and performing other particular operations as follows:

1. Mow grass at regular intervals to maintain at a maximum height of 2½ inches. Do not cut more than 1/3 of grass blade at any one mowing.
2. Neatly trim edges and hand clip where necessary.
3. Immediately remove clippings after mowing and trimming. Dispose of clippings in accordance with all local regulations.
4. Water to prevent grass and soil from drying out.
5. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
6. Immediately reseed areas which show bare spots.
7. Protect seeded areas with warning signs during maintenance period.

END OF SECTION

SECTION 03300 – CAST-IN-PLACE CONCRETE**PART 1 – GENERAL****1.01 SECTION INCLUDES**

- A. Cast-in-place concrete materials, mixes, formwork and reinforcing.

1.02 REFERENCES

- A. American Concrete Institute, ACI
 - 1. ACI 301, Specifications for Structural Concrete for Buildings
 - 2. ACI 347, Formwork of Concrete
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A615, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 2. ASTM C94, Standard Specifications for Ready-Mixed Concrete.
 - 3. ASTM C260, Standard Specifications for Air-Entraining Admixtures for Concrete.
 - 4. ASTM C494, Standard Specifications for Chemical Admixtures for Concrete.
- C. Commonwealth of Pennsylvania Department of Transportation (PADOT) Specifications Publication 408, as supplemented.
 - 1. PADOT Section 704 Cement Concrete
 - 2. PADOT Section 1001 Cement Concrete Structures

1.03 SYSTEM DESCRIPTION

- A. Design Requirements
 - 1. Unless otherwise indicated on Drawings or Specifications, use Class A concrete for structures, sidewalks, pads, footers, and cast-in-place manhole or chamber components. Provide Class A

concrete air entrained with a minimum compressive strength of 4,000 pounds per square inch at 28 days.

2. Class B concrete may be used for backfilling overexcavated foundations, fill concrete, foundation voids and cavities, and concrete cradle and encasement. Provide Class B concrete air entrained with a minimum compressive strength of 3,000 pounds per square inch at 28 days.
3. Use H.E.S. concrete for reaction backings. Provide H.E.S. concrete air entrained with a minimum mix design compressive strength of 3,000 psi at 3 days, and minimum compressive strength of 3,500 psi at 28 days.

1.04 SUBMITTALS

- A. Samples: Submit samples of materials being used as specified and when requested by ENGINEER. Include names, sources and descriptions.
- B. Certificates: Furnish ENGINEER and local authorities if required, certificates originated by batch plant certifying ready mixed concrete as manufactured and delivered to be in conformance with ASTM C94.
- C. Delivery Tickets: Furnish delivery tickets to accompany each load of concrete from batch plant. Information presented on ticket to include tabulation covered by ASTM C94, 15.1.1 through 15.2.8, as well as any additional information local codes require. Tickets required to be signed by CONTRACTOR's representative, noted as to time and place of pour and kept in a record at site. Make records available for inspection upon request by ENGINEER.
- D. Test Reports: Submit test reports specified.
- E. Design Mix: Prior to production of concrete, submit a design mix for approval.
- F. Schedule: Submit schedule indicating methods and sequence of pouring before concrete is placed.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide concrete materials conforming to ACI 301 except as noted.
- B. Provide H.E.S. concrete materials conforming to PADOT Section 704.

- C. Reinforcement: New billet steel conforming to ASTM A615, Grade 60, deformed. Rail-steel bars not allowed.
- D. Formwork: Provide formwork designed and constructed in accordance with ACI 347 to required dimensions, plumb, straight, and mortar tight.
- E. Concrete Support Forms: Spirally constructed of laminated plies of fiber with a non-water sensitive adhesive and wax impregnated exterior surface.
 - 1. Sonoco Products Company, Sonotube Fibre Form.
- F. Admixtures:
 - 1. Provide concrete with water reducing and retarding admixture when placed at ambient air temperatures about 75 deg. F. When temperatures are below 75 deg. F., use a water reducing admixture. Water reducing and retarding admixture to conform to ASTM C494 for Type D, and water reducing admixture to Type A. Proportioning and mixing as recommended by manufacturer.
 - 2. Do not use admixtures causing accelerated setting of cement in concrete.
 - 3. Do not use admixtures containing sugar, calcium chloride or other chlorides.
 - 4. Store admixtures in a manner to prevent contamination, evaporation or damage.
 - 5. Air-entertainment admixtures to conform to ASTM C260.
 - 6. Calcium Chloride is not permitted.
- G. Epoxy Bonding Compound: Use product such as A.C. Horn "Epoxite Binder," Sika Chemical "Sikadur Hi-Mod," Dural International "Duralbond:" or approved equal.
- H. Patching Cement: Use product such as Sika Chemical "Sikatop 123" or approved equal.

PART 3 - EXECUTION

3.01 PLACEMENT OF NEW CONCRETE

- A. Mix, place, cure and finish Class A and B concrete as specified in ACI 301 except as noted.
- B. Mix, place, and cure H.E.S. concrete as specified in PADOT Section 704 and PADOT Section 1001.
- C. Notify ENGINEER at least 24 hours prior to proposed placement of concrete.
- D. Field Tests: One slump test for each batch of concrete performed prior to placement in forms. An allowable slump of 2 inches to 4 inches allowable if consolidation is by vibration or 2 inches to 5 inches allowable if consolidation is by methods other than vibration.
- E. Do not weld reinforcing bars.

3.02 REPAIRS TO CONCRETE SURFACES

- A. Cut out concrete found to be cracked or spalled to a sound surface. Remove loose concrete and rust on exposed reinforcement and clean surface of dust, dirt, and foreign matter using stiff nylon or bristle brushes and clean water.
- B. Prepare cut away portions according to manufacturer's instructions.
- C. Fill deteriorated areas with approved patching cement in successive layers not exceeding manufacturer's instructions for application.
- D. Final patching to restore original surfaces and profile.

END OF SECTION

SECTION 03600 - GROUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Grout for construction as set forth on the Drawings and in other Sections of these Specifications.

1.02 RELATED WORK

- A. Cast-in-Place Concrete: Section 03300.
- B. Individual grouting requirements as specified in various other Sections of these Specifications.

1.03 REFERENCES

- A. American Concrete Institute (ACI)
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM C 191, Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.
 - 2. ASTM C 596, Test Method for Drying Shrinkage of Mortar Containing Portland Cement.
 - 3. ASTM C 827, Test Method for Early Volume Change of Cementitious Mixtures.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Prevent moisture damage and contamination of materials.
- B. Store materials in undamaged condition with seals and labels intact as packaged by the manufacturer.

1.05 SITE CONDITIONS

- A. Protect against high and low temperatures and bad weather in accordance with American Concrete Institute standards for placement of concrete.

1.06 SUBMITTALS

- A. Submit product data according to Section 01300.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Non-Shrink Non-Metallic Grout: Factory Premixed material containing no corrosive irons, aluminums, chemicals or gypsums.

1. Manufacturers
 - a. U.S. Grout Corporation
 - b. Five Star
 - c. or Equal
2. Grouts containing water reducers, accelerators, or fluidifiers shall have no drying shrinkage greater than the equivalent cement and water mix as tested per ASTM C 596.
3. Grout shall be nonshrink before initial set and show no expansion after set as tested per ASTM C 827.
4. Initial set of grout not less than 60 minutes per ASTM C 191 Test.
5. Use Type I (Normal) cement for grout applications not in contact with sewage.
6. Use Type II (Sulfate Resistant) cement for grout applications in contact with sewage.

2.02 GROUT QUALITY

- A. Use ready-mix type requiring only the addition of water. Do not add other materials. Water requirement proportions shall conform to manufacturer's specifications for the desired mix consistency.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Forming:
 - 1. Use forming procedures that allow proper and complete placement of grout.
 - 2. Anchor support elements so no movement is possible.
 - 3. Remove supports only after grout has hardened.
 - 4. Pre-treat with forming oils wood forms that may absorb moisture.
- B. Preparation of Surface: Prepare in accordance with manufacturer's printed instructions.

3.02 MIXING

- A. Time: In accordance with manufacturer's printed instructions.

3.03 PLACING

- A. Perform grout placement in accordance with the recommendations of ACI and the manufacturer's published specifications for mixing and placing. Place non-shrink non-metallic grout only where indicated on Drawings.

END OF SECTION

SECTION 11300 - PACKAGE GRINDER PUMPING STATION**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Semi-Positive Displacement Type Grinder Pump Stations
- B. Related appurtenances.

1.02 GENERAL DESCRIPTION:

The MANUFACTURER shall furnish complete factory-built and tested Grinder Pump Station(s), each consisting of grinder pump(s) suitably mounted in a basin constructed of high density polyethylene (HDPE) for simplex stations and HDPE or Fiberglass Reinforced Polyester Resin for duplex stations, NEMA 6P electrical quick disconnect (EQD), pump removal system, shut-off valve, anti-siphon valve, check valve, each assembled in the basin, electrical alarm panel, and all necessary internal wiring and controls. Component type grinder pump systems that require field assembly will not be acceptable, due to the potential problems that can occur during field assembly. All components and materials shall be in accordance with section 2.0 of this Product Specification. For ease of serviceability, all pump, motor/grinder units shall be of like type and horsepower throughout the system.

1.03 SUBMITTALS:

After receipt of notice to proceed, the MANUFACTURER shall furnish a minimum of six (6) sets of shop drawings detailing the equipment to be furnished including dimensional data and materials of construction. The ENGINEER shall promptly review this data, and return two (2) copies as accepted, or with requested modifications. Upon receipt of accepted shop drawings, the MANUFACTURER shall proceed immediately with fabrication of the equipment.

1.04 MANUFACTURER:

1. Grinder pump stations, complete with all appurtenances, form an integral system, and as such, shall be supplied by one grinder pump station manufacturer. The CONTRACTOR shall be responsible for the satisfactory operation of the entire system. The equipment specified shall be a product of a company experienced in the design and manufacture of grinder pumps for specific use in low pressure sewage systems. The company shall submit detailed installation and user instructions for its product, submit evidence of an established service program including complete parts and service manuals, and be responsible for maintaining a continuing inventory of grinder pump replacement parts. The MANUFACTURER shall provide a reference and contact list from ten of its

largest contiguous grinder pump installations of the type of grinder pumps described within this specification.

2. Manufacturers:
 - a. Environment One Corporation
 - b. Hydromatic
 - c. Or Equal
3. Attention is directed to the fact that the drawings and overall system design are based on a particular piece of equipment from a particular manufacturer. These specifications are intended to provide guidelines for standard equipment of a recognized manufacturer who already meets all the requirements of this specification.
4. ALTERNATE EQUIPMENT:

In the event that the CONTRACTOR or another supplier proposes an Alternate to the specified MANUFACTURER, the ENGINEER recognizes that it will be difficult to conform to certain details of this Specification due to different manufacturing techniques or grinder pump station designs. If proposing an Alternate, the CONTRACTOR (supplier) must submit, no less than 15 business days in advance of the bid date, a complete description of any changes that will be necessary to the system design, a complete submittal package as outlined in Section 1.02 SUBMITTALS, a system hydraulic analysis (including pipe sizes, flows, velocities, retention times and number and location of recommended valves and cleanouts, if any) based on the proposed pump, a list of exceptions to this Specification, and demonstration of compliance to Section 1.04 EXPERIENCE CLAUSE of this Specification. This information must be submitted to the ENGINEER for pre-approval of the alternate equipment being proposed and determination of compliance with these Contract Documents. If the equipment differs materially or differs from the dimensions given on the Drawings, the CONTRACTOR (supplier) shall submit complete drawings showing elevations, dimensions, or any necessary changes to the Contract Documents for the proposed equipment and its installation. Pre-approval, if granted, will be provided in writing by the ENGINEER to the CONTRACTOR (supplier) at least five business days in advance of the bid date. If the ENGINEER'S approval is obtained for Alternate Equipment, the CONTRACTOR (supplier) must make any needed changes in the structures, system design, piping or electrical systems necessary to accommodate the proposed equipment at the expense of the CONTRACTOR (supplier).

1.03 EXPERIENCE CLAUSE:

The equipment furnished hereunder shall be the product of a company experienced in the design and manufacture of grinder pumps specifically designed for use in low pressure systems. All manufacturers proposing equipment for this project shall have at least ten (10) years of experience in the design and manufacture of units of identical size(s) and performance to the specified units. All manufacturers proposing equipment for this

project must also have not less than five hundred (500) successful installations of low pressure sewer systems utilizing grinder pumps of like type to the grinder pumps specified herein. An installation is defined as a minimum of twenty-five (25) pumps discharging into a common force main which forms a low pressure sewer system. The contractor (supplier) proposing alternate equipment shall also submit, as part of the bid schedule, an installation list with contact person(s), phone number(s) and date(s) of installation of at least ten (10) installations of the type of pump specified herein that have been in operation for at least 10 years.

In lieu of this experience clause, the contractor (supplier) of alternate equipment will be required to submit a five (5) year performance bond for one-hundred (100) percent of the stipulated cost of the equipment as bid and as shown in the Bid Schedule. This performance bond will be used to guarantee the replacement of the equipment in the event that it fails within the bond period.

1.05 OPERATING CONDITIONS:

The pumps shall be capable of delivering 15 GPM against a rated total dynamic head of 0 feet (0 PSIG) and 9 GPM against a rated total dynamic head of 138 feet (60 PSIG). The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valving be allowed to create a false apparent head.

1.06 WARRANTY:

The grinder pump MANUFACTURER shall provide a part(s) and labor warranty on the complete station and accessories, including, but not limited to, panel and redundant check valve, for a period of twenty-four (24) months after notice of OWNER'S acceptance, but no greater than twenty-seven (27) months after receipt of shipment. Any manufacturing defects found during the warranty period will be reported to the MANUFACTURER by the OWNER and will be corrected by the MANUFACTURER at no cost to the OWNER.

1.07 WARRANTY PERFORMANCE CERTIFICATION:

As a bid certification requirement, each bidder shall provide with their bid schedule a Warranty Performance Certification statement executed by the most senior executive officer of the grinder pump MANUFACTURER, which certifies a minimum of a twenty four (24) month warranty. They must further detail any exclusions from the warranty or additional cost items required to maintain the equipment in warrantable condition, including all associated labor and shipping fees, and certify that the MANUFACTURER will bear all costs to correct any original equipment deficiency for the effective period of the warranty. All preventive maintenance type requirements shall be included in this form as exclusions. These requirements include, but are not limited to, unjamming of grinder mechanism, unplugging of lines, periodic motor maintenance, and periodic cleaning of liquid level controls. Should the CONTRACTOR (supplier) elect to submit a performance bond in lieu of the experience clause outlined above, this Warranty Performance Certification shall also be used as a criterion to evaluate the CONTRACTOR'S (supplier's) performance over the warranty period. A Warranty

Performance Certification form is included with the bid schedule and must be completed and submitted as part of the bid package. Bids with incomplete forms or missing forms will be considered nonresponsive.

PART 2 - PRODUCT

2.01 PUMP:

The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. Plating on the rotor will not be acceptable due to its tendency to delaminate. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. The material shall be suitable for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, excellent aging properties, and outstanding wear resistance. Buna-N is not acceptable as a stator material because it does not exhibit the properties as outlined above and required for wastewater service.

2.02 GRINDER:

- A. The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft. The grinder impeller assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable. The grinder will be of the rotating type with a stationary hardened and ground stainless steel shredding ring spaced in close annular alignment with the driven impeller assembly, which shall carry two hardened type 400 series stainless steel cutter bars.
- B. This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to eliminate clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:
 - 1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.
 - 2. The maximum flow rate through the cutting mechanism must not exceed 4 feet per second. This is a critical design element to prevent jamming and as such must be adhered to.
 - 3. The inlet shroud shall have a diameter of no less than 5 inches. Inlet shrouds that are less than 5 inches in diameter will not be accepted due to

their inability to maintain the specified 4 feet per second maximum inlet velocity which by design prevents unnecessary jamming of the cutter mechanism and eliminates blinding of the pump by large objects blocking the inlet shroud.

4. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.
- C. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic, glass, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter stainless steel discharge piping.

2.03 ELECTRIC MOTOR:

As a maximum, the motor shall be a 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, air-cooled induction type with a low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc., for the application. Non-capacitor start motors or permanent split capacitor motors will not be accepted because of their reduced starting torque and consequent diminished grinding capability. To reduce the potential of environmental concerns, the expense of handling and disposing of oil, and the associated maintenance costs, oil-filled motors will not be accepted.

2.04 MECHANICAL SEAL:

The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

2.05 TANK AND INTEGRAL ACCESSWAY (Model 2010) High Density Polyethylene Construction:

- A. The tank shall be made of high density polyethylene, with a melt index of 2.0 grams/10 minutes or lower to assure high environmental stress cracking resistance. Corrugated sections are to be made of a double wall construction with the internal wall being generally smooth to promote scouring. Corrugations of the outside wall are to be of a minimum amplitude of 1 1/2" to provide necessary transverse stiffness. Any incidental sections of a single wall construction are to be a minimum .250 inch thick. All seams created during tank construction are to be thermally welded and factory tested for leak tightness. Tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth.

All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.

- B. The tank shall be furnished with one EPDM grommet fitting to accept a 4.50" OD DWV or Schedule 40 pipe. Tank capacities shall be manufacturer's standard for the depth specified. Depth of the tank shall be that necessary to allow the invert elevation of the sewage influent pipe to be a minimum of 4'-0" below finished grade. Each of the supplied pump stations shall be the same depth.
- C. The accessway shall be an integral extension of the wet well assembly and include a lockable cover assembly providing low profile mounting and watertight capability. Accessway design and construction shall enable field adjustment of station height in increments of 4" or less without the use of any adhesives or sealants requiring cure time before installation can be completed.
- D. The station shall have all necessary penetrations molded in and factory sealed. To ensure a leak free installation no field penetrations shall be acceptable.
- E. All discharge piping shall be constructed of 304 Series Stainless Steel and terminate outside the accessway bulkhead with a stainless steel, 1 1/4 inch female NPT fitting. The discharge piping shall include a stainless steel ball valve rated for 200 psi WOG; PVC ball valves will not be accepted. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.
- F. The accessway shall include a single NEMA 6P electrical quick disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. The accessway shall also include a 2-inch PVC vent to prevent sewage gases from accumulating in the tank.

2.06 CHECK VALVE:

- A. The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the stainless steel discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts will be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded part made of glass filled PVC. Ball type check valves are unacceptable due to their limited sealing capacity in slurry applications.

- B. Each grinder pump installation shall also include one separate check valve of the type detailed in Section 2.08 for installation in the 1 1/4" service lateral between the grinder pump station and the sewer main, preferably next to the curb stop. The separate check valve shall be provided as a separate line item in the bid schedule.

2.07 ANTI-SIPHON VALVE:

The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the stainless steel discharge piping. Moving parts will be made of 300 series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from a glass-filled thermoplastic resin. Holes or ports in the discharge piping are not acceptable anti-siphon devices, due to their tendency to clog from the solids in the slurry being pumped.

2.08 CORE UNIT:

The Grinder Pump Station shall have cartridge type, easily removable core assembly consisting of pump, motor, grinder, all motor controls, check valve, anti-siphon valve, level control, electrical quick disconnect and wiring. The watertight integrity of each core unit, shall be established by 100 percent factory test at a minimum of 5 PSIG.

2.09 CONTROLS:

- A. All necessary controls, including motor and level controls, shall be located in the top housing of the core unit. The top housing will be attached with stainless steel fasteners.
- B. Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch. The level detection device shall have no moving parts in direct contact with the wastewater. High-level sensing will be accomplished in the manner detailed above by a separate air-bell sensor and pressure switch of the same type. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump ON/OFF and High-level alarm functions shall not be controlled by the same switch. Float switches of any kind, including float trees, will not be accepted due to the periodic need to maintain (rinsing, cleaning) such devices.
- C. To assure reliable operation of the pressure switches, each core shall be equipped with a breather assembly, complete with a suitable means to prevent accidental entry of water into the motor compartment. The grinder pump will be furnished with a 6 conductor 14 gauge, type SJOW cable, pre-wired and watertight to meet

UL requirements with a FACTORY INSTALLED NEMA 6P EQD half attached to it.

2.10 ALARM PANEL:

- A. Each grinder pump station shall include a NEMA 4X, UL listed ALARM PANEL suitable for wall mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic to assure corrosion resistance. The enclosure shall include a hinged, lockable cover, padlock, and secured dead front. The enclosure shall not exceed 11.38"W x13.5"H x 5.63"D.
- B. For each core, the panel shall contain one (1) 15 amp, double pole circuit breaker for the power circuit and one (1) 15 amp single pole circuit breaker for the alarm circuit. The panel shall contain terminal blocks, integral power bus, push to run feature and a complete alarm circuit.
- C. The Alarm Panel shall include the following features: audio & visual alarm, push-to-run switch, and high level (redundant) pump starting control. The alarm sequence is to be as follows:
 - 1. When liquid level in the sewage wet-well rises above the alarm level, visual and audio alarms will be activated. The contacts on the alarm pressure switch will close. The redundant pump starting system will be energized.
 - 2. The audio alarm may be silenced by means of the externally mounted, push-to-silence button.
 - 3. Visual alarm remains illuminated until the sewage level in the wet-well drops below the "off" setting of the alarm pressure switch.
- D. The visual alarm lamp shall be inside a red fluted lens at least 2 5/8" in diameter and 1 11/16" in height. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating. For duplex units, in addition to the above, two high level indicator lights shall be mounted behind the access cover.
- E. During a high level alarm condition on a duplex station, the appropriate light will illuminate to indicate which pump core requires servicing. The audio alarm shall be a printed circuit board in conjunction with an 86 dB buzzer with quick mounting terminal strip mounted in the interior of the enclosure. The audio alarm shall be capable of being deactivated by depressing a push-type switch which is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure.
- F. The entire Alarm Panel as manufactured, shall be listed by Underwriters Laboratories, Inc.

2.11 SERVICEABILITY:

The grinder pump core unit shall have two lifting hooks complete with nylon lift-out harness connected to its top housing to facilitate easy core removal when necessary. All mechanical and electrical connections must provide easy disconnect capability for core unit removal and installation. A push-to-run feature will be provided for field trouble shooting. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

2.12 OSHA CONFINED SPACE:

All maintenance tasks for the grinder pump station must be possible without entry into the grinder pump station (as per OSHA 1910.146 Permit-required confined spaces).

"Entry means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space."

2.13 SAFETY:

- A. The Grinder Pump shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired Grinder Pump Station shall be listed by Underwriters Laboratories, Inc., to be safe and appropriate for the intended use. UL listing of components of the station, or third-party testing to UL standard will not be acceptable.
- B. The grinder pump shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low pressure sewer system applications. As evidence of compliance with this requirement, the grinder pump shall bear the seal of NSF International. Third-party testing to NSF standard will not be acceptable.

PART 3 - EXECUTION**3.01 FACTORY TEST:**

- A. Each grinder pump shall be submerged and operated for 5 minutes (minimum). Included in this procedure will be the testing of all ancillary components such as, the anti-siphon valve, check valve, discharge assembly and each unit's dedicated level controls and motor controls. All factory tests shall incorporate each of the above listed items. Actual appurtenances and controls which will be installed in the field, shall be particular to the tested pump only. A common set of

appurtenances and controls for all pumps will not be acceptable. Certified test results shall be available upon request showing the operation of each grinder pump at two (2) different points on its curve, with the maximum pressure no less than 60 psi. The ENGINEER reserves the right to inspect such testing procedures with representatives of the OWNER, at the GRINDER PUMP MANUFACTURER'S facility.

- B. All completed stations shall be factory leak tested to assure the integrity of all joints, seams and penetrations. All necessary penetrations such as inlets, discharge fittings and cable connectors shall be included in this test along with their respective sealing means (grommets, gaskets etc.).

3.02 DELIVERY:

All Grinder Pump units will be delivered to the job site 100 percent completely assembled, including testing, ready for installation. Grinder pump units will be individually mounted on wooden pallets.

3.03 INSTALLATION:

NOT REQUIRED FOR THIS CONTRACT

3.04 BACKFILL REQUIREMENTS:

NOT REQUIRED FOR THIS CONTRACT

3.05 START-UP AND FIELD TESTING:

NOT REQUIRED FOR THIS CONTRACT

PART 4 - OPERATION AND MAINTENANCE

4.01 SPARE CORE:

NOT REQUIRED FOR THIS CONTRACT

4.02 MANUALS:

For each pump station, supply three (3) copies of Operation and Maintenance Manuals to the ENGINEER for distribution to ultimate owners of pumping stations.

END OF SECTION

SECTION 11400 - WASTEWATER COMBINATION AIR VALVE**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Combination Air Valve

1.02 GENERAL DESCRIPTION:

The CONTRACTOR shall furnish and install wastewater combination air valves which shall perform the functions of both wastewater air release and wastewater air vacuum valves.

1.03 SUBMITTALS:

After receipt of notice to proceed, the MANUFACTURER shall furnish a minimum of six (6) sets of shop drawings detailing the equipment to be furnished including dimensional data and materials of construction. The ENGINEER shall promptly review this data, and return two (2) copies as accepted, or with requested modifications. Upon receipt of accepted shop drawings, the MANUFACTURER shall proceed immediately with fabrication of the equipment.

1.04 MANUFACTURER:

- A. The manufacturer shall demonstrate a minimum of (5) years experience in the manufacture of wastewater air valves. The valves shall be manufactured and tested in accordance with American Water Works Association Standard (AWWA) C512. Submittals for approval shall include dimensional drawing, parts list, and operation and maintenance manuals.
- B. Wastewater combination air valves shall be Model D-020 as manufactured by ARI or approved equal.

1.05 OPERATING CONDITIONS:

- A. All valves shall be suitable for pressures up to 230 psig.
- B. The valve shall perform the functions of both wastewater air release and wastewater air vacuum valves and be furnished as a single body.
- C. Air valves shall be automatic float operated valves designed to exhaust air during the filling of a piping system and close upon liquid entry. The valve shall open

during draining or if a negative pressure occurs. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure.

PART 2 - PRODUCT

2.01 COMBINATION AIR VALVE:

A. Design

1. Conical shaped body and float stem to keep operating mechanisms and orifice openings free from contact with liquid during purging of air. The valve seat shall provide complete shut off to the full valve pressure rating.
2. Funnel shaped lower body.
3. Valves shall have incorporate a full port orifice, a seal plug assembly, and an upper and lower float to provide a rolling resilient seal.
4. The seal shall be a one-piece design and include a large orifice (1.25 square inches) and a small orifice (0.018 square inches) and each shall open or close as needed to allow release or intake of air as the demand on the system regulates.
5. Valve shall be designed to intake or discharge a minimum of 100 SCFM of air with a 3.5-psi differential pressure.
6. The valve shall be no more than 26-inches high.
7. The entire valve assembly shall not weigh more than 35 pounds.

B. Materials – All materials of construction shall be corrosion resistant as follows:

1. Valve body, cover, lower float, stem, washer, spring, nuts and bolts: 316 Stainless Steel.
2. Upper float: Foamed polypropylene.
3. O-rings: Buna-N.
4. Seal plug assembly and base: Reinforced nylon
5. The exterior of the valve shall not be coated.

C. Connections

1. Inlet size: 2-inches, male NPT
2. Outlet size: 1-1/2 inch, male Kamlock fitting, polypropylene
3. Shut-off valve: 2-inch, at bottom inlet, quarter-turn, full ported stainless steel
4. Drain valve: 1-inch, near bottom of valve body, quarter-turn, full port, stainless steel

PART 3 - EXECUTION

- 3.01 **INSTALLATION:** The CONTRACTOR shall furnish and install wastewater combination air valves as shown on the plans

END OF SECTION