SECTION 704 SEWAGE FORCE MAINS

704.01 DESCRIPTION. This work shall consist of the furnishing of all labor, equipment, tools and materials to install force mains as required by the Plans, Special Conditions and these Specifications.

704.02 MATERIALS. Materials for pressure sewage force mains shall conform to the following requirements:

(a) DUCTILE IRON PIPE. Ductile iron pipe shall be push-on joint, pressure, bituminous exterior coated and shall conform to AWWA C 151, latest revisions. For 12-inch and smaller pipe provide minimum Pressure Class 350. For piping from 14-inch to 20-inch provide minimum Pressure Class 250 and for 24-inch and larger piping provide Pressure Class 200. Where pipe-laying conditions require greater strengths than the minimum pressure class, Thickness Design shall be according to AWWA C150. Pipe shall have an internal polyethylene lining with a minimum thickness of 0.035 inch. Polyethylene material shall conform to ASTM D 1248.

For any installation requiring polyethylene encasement for corrosion protection of ductile-iron pipe, the encasement shall be in accordance with AWWA C105.

Restrained, push-on joint pipe shall be similar and equal to one of the following: American Ductile Iron Pipe's FLEX-RING JOINT pipe or U.S. Pipe's TR FLEX pipe.

(b) PVC PIPE. Polyvinyl chloride (PVC) pressure pipe shall conform to AWWA C900, latest revision for piping 12-inch and smaller. PVC pipe shall have cast iron outside diameter, elastomeric-gasket type joints and shall have a minimum working pressure rating of 200 psi. Pipe manufacturer shall furnish certification of compliance with the reference standards.

(c) FITTINGS. Fittings shall be gray-iron or ductile-iron conforming to AWWA C 153 Standard for Ductile Iron Compact Fittings. Fittings shall be mechanical joint, polyethylene lined, exterior bituminous coated and shall have a minimum working pressure rating of 250 psi. Polyethylene lining shall conform to ASTM D 1248 and shall be 0.035 inch minimum thickness.

(d) MISCELLANEOUS FITTINGS. Couplings, adapters and related fittings shall conform to Section 601 of these specifications.

(e) TRACER WIRE. Tracer wire shall be solid copper, AWG No. 14.

(f) GRAVEL BEDDING. Gravel bedding shall conform to Section 205 of these specifications.

(g) CONCRETE. Concrete shall conform to Section 401 of these specifications. Concrete shall be Class B (2500 psi), unless noted otherwise.

(h) COMBINATION AIR VALVES. Combination air valves shall be of the size shown on the plans and shall be Model D-020 as manufactured by A.R.I. Flow Control Accessories or an approved equal.

704.03 CONSTRUCTION REQUIREMENTS. Force mains shall be constructed in accordance with Section 601.05 of these specifications and as shown on the plans.

704.04 ACCEPTANCE TESTS FOR FORCE MAINS. All force main piping shall be subject to a hydrostatic and leakage test. The hydrostatic and leakage test procedures shall be conducted in accordance with Section 601.06 of these specifications.

(a) Hydrostatic Test. The hydrostatic test shall be performed at a test pressure determined by the following formula:

Test Pressure = Total design head pressure (psi) X 1.5

The test pressure must be maintained for at least two hours.

(b) Leakage Test. The leakage test shall be performed concurrently with the hydrostatic test. Leakage shall be considered as the volume of water added to maintain the test pressure determined by the formula above. Allowable leakage must not exceed the volume as determined by the following formula:

$$L = \frac{S\ D\ P^{1/2}}{133{,}200}$$

in which:

L is the allowable leakage (makeup water), in gallons per hour;
S is the length of pipeline tested, in feet;
D is the nominal diameter of the pipe, in inches;
P is the average test pressure during the leakage test, in pounds per square inch gage.

If testing results in leakage greater than the allowed maximum; the defective pipe and joint(s) shall be located and repaired. When repair work is complete, tests shall be performed again to determine that leakage is within the allowable limit.

704.05 MEASUREMENT AND PAYMENT. Force main will be measured by the linear foot along the centerline of the pipe from point of connection to lift station, manhole or other designated location. Payment for force main at the contract unit price for the size and type of pipe listed in the proposal shall be full compensation for furnishing and installing pipe and fittings, and for excavation, trenching, backfilling, gravel bedding, tracer wire, concrete blocking, testing and related work.

When listed in the proposal, cast and ductile iron fitting will be measured and paid for as a separate item. Iron fittings will be measured by the listed weight in pounds, excluding gland, bolts and accessories, as given in AWWA C 153.

Combination air valves will be measured and payment made according to the type and size furnished and installed including vault and appurtenances.

No separate payment will be made for concrete thrust blocking or concrete encasement unless otherwise specified and listed in the proposal.

Rock excavation, gravel bedding and select backfill, when listed in the proposal, will be measured and paid for as specified in Section 205 of these specifications.

Street and highway crossings and driveway and sidewalk removal and replacement will be measured and

payment made as specified in other sections of these specifications.

Payment will be made under:

Pay Item	Pay Unit
Pipe (Size and Type)	LF
Fittings	LBS
Combination Air Valve (Size)	EA

**** END OF SECTION 704 ****