

SECTION 7

SPECIFICATIONS FOR FORCE MAINS

7.01 DESCRIPTION OF WORK

The work must consist of furnishing and installing force main of the specified sizes at the depths shown on the drawings or specified herein, and furnishing all fittings and joint material, all labor, materials, tools, and equipment for receiving, unloading, transporting, laying, and testing of force main pipe and fittings. Contractor must furnish all necessary accessories to complete the pipe work as shown on the drawings and specified herein. Excavating, Trenching and Backfilling must be as specified in Section 2 of the Georgetown Charter Township Standard Specifications.

The work must be performed in accordance with the Specifications and Drawings, the MDOT 2020 Standard Specifications for Construction and the following specifications.

The force main connection manhole and the first manhole downstream of the connection manhole must be made corrosion resistant per 6.02.06.02 and 6.13.03 of Section 6 Specifications for Sanitary Sewer.

7.02 MATERIALS

All materials furnished by the Contractor must conform to the Specifications which follow. Where reference specifications are mentioned the current edition or latest issue must be used.

All materials must be American or Canadian made unless otherwise allowed in the Project Technical Specifications or approved by the Township.

7.02.01 Ductile Iron Pipe

7.02.01.01 Pipe

Ductile iron pipe must conform to the requirements of AWWA C151 (ANSI A21.51). Ductile iron pipe must be Class 52 unless otherwise specified.

All pipe must have a cement mortar lining with seal coat conforming to the requirements of AWWA C104 (ANSI A21.4). All ductile iron pipe must be encased in a seamless polyethylene tube.

7.02.01.02 Fittings

All fittings must be ductile iron in accordance with AWWA C153 (ANSI A21.53). Fittings twenty-four (24) inches in diameter and smaller must have a minimum

pressure rating of 350 psi; fittings larger than twenty-four (24) inches in diameter must have a minimum pressure rating of 250 psi.

Fittings must have either cement mortar lined with seal coat in accordance with AWWA C104 (ANSI A21.4) or fusion bonded epoxy coating in accordance with AWWA C116 (ANSI A21.16). All ductile iron fittings must be encased in a seamless polyethylene tube.

7.02.01.03 Joints

Unless otherwise specified, all pipe joints must be rubber gasket joints conforming to the requirements of AWWA C111 (ANSI A21.11) for bolted mechanical joints or push-on joints. Joints on fittings must be bolted mechanical joints. Joints on fittings must be restrained in accordance with Section 7.11. Bolts must be corrosion-resistant, high strength low alloy steel that conforms to ANSI/AWWA C111/A21.11 and must be Cor-Blue or an approved equal.

Push-on restrained joint pipe must be first approved by the Township. If approved, all ductile iron restrained joint pipe must be Clow Corporation "Super-Lock", American Ductile Iron Pipe "Lok-Ring Joint" or Flex-Ring Joint, Griffen Pipe Products Co. "Snap-Lok", or approved equal. The Township will first encourage the use of EBAA Iron Sales Megalug or approved equal to restrain pipe.

7.02.01.04 Plastic Wrap for Pipe

All pipe and fittings must be encased in a seamless polyethylene tube, in accordance with AWWA C105 (ANSI A21.5) of eight (8) mills minimum thickness. The ends of adjacent sections of polyethylene tubing must be overlapped a minimum of one (1) foot, and the joint taped or otherwise secured to prevent displacement during backfill operations.

When plastic wrap is being used, the wrap must be extended beyond the exposed portion of existing mains being connected to and secured to the pipe.

7.02.02 Polyvinyl Chloride (PVC) and Molecularly Oriented PVC (PVCO) Pipe

(When approved by Township or specified in project specifications.)

7.02.02.01 Pipe

Polyvinyl chloride (PVC) pipe, six (6) inch through twelve (12) inch diameter, must conform to ANSI/AWWA C900. The pipe must have a pressure rating of 235 psi. The PVC pressure pipe must have an outside diameter equivalent to cast iron and ductile iron pipe.

Molecularly Oriented Polyvinyl Chloride (PVCO) pipe six (6) inch through twelve (12) inch diameter must conform to ANSI/AWWA C909. The pipe must have a pressure rating of 235 psi. The PVCO pressure pipe must have an outside

diameter equivalent to cast iron and ductile iron pipe.

Pipe color must be green or as required by the Township.

7.02.02.02 Fittings

Fittings must be ductile iron as specified in Section 7.02.01.02.

Anchorage (restraint) of bends, tees, plugs and all other fittings must be per Section 7.11 of this specification.

7.02.02.03 Joints

Joints must be bell and spigot with elastomeric rubber gasket conforming to Section 4 of AWWA C900 or C909, as applicable.

7.02.03 High Density Polyethylene (HDPE)

7.02.03.01 Materials

Pipe must be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material must meet the specifications of ASTM D3350 with a minimum cell classification of PE445474C. Pipe must have a manufacturing standard of ASTM D3035 and be manufactured by an ISO 9001 certified manufacturer. The pipe must contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe must be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects. The polyethylene compound must be suitably protected against degradation by ultraviolet light by means of carbon black of not less than 2 percent. The manufacture of the HDPE resin must certify the cell classification indicated.

Pipe sizes six-inch and larger must have a manufacturing standard of ASTM F714. Dimension Ratio (DR) and Outside Diameter (IPS/DIPS) must be as specified on the drawings.

The pipe must have a minimum working pressure rating of 160 psi. Pipe must be supplied with a permanently co-extruded green stripe on the pipe outside surface as part of the pipe's manufacturing process.

7.02.03.02 Fittings

7.02.03.02.01 Butt Fusion Fittings

Fittings must be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material must meet the specifications of ASTM D3350 with a minimum cell classification of PE445474C. Molded butt fusion fittings must be in accordance with ASTM D3261 and must be manufactured by

injection molding. Fabricated fittings must be in accordance with ASTM F2206 and be manufactured by a ISO 9001 certified facility. All fittings must be pressure rated to provide a working pressure rating no less than that of the pipe. The fitting must be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

7.02.03.02.02 Electrofusion Fittings

Electrofusion fittings must be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material must meet the specifications of ASTM D3350 with a minimum cell classification of PE445474C and be the same base resin as the pipe.

Electrofusion fittings must have a manufacturing standard of ASTM F1055. All fittings must be pressure rated to provide a working pressure rating no less than that of the pipe.

7.02.03.02.03 Flanged and Mechanical Joint Adapters

Flanged and mechanical joint adapters must be PE 4710 HDPE, cell classification of 445474C as determined by ASTM D3350 and be the same base resin as the pipe. Flanged and mechanical joint adapters must have a manufacturing standard of ASTM D3261. All adapters must be pressure rated to provide a working pressure rating no less than that of the pipe.

7.02.04 Resilient Seated Gate Valves

Resilient seated gate valves must be added at manifolds of force main or as shown on the drawings.

All valves must conform to AWWA C509 or C515, Standards for Resilient-Seated Gate Valves for Water Supply Service. The valves must be fully bronze mounted and must be furnished with O-ring packing. The direction of the opening must conform to the Owners standards.

Valves must be EJ FlowMaster, Clow Valve Co. R/W Resilient Wedge, American Resilient Wedge, or equal.

7.02.05 Tracer Wire

Two (2) tracer wires must be placed with all PVC and HDPE pipe installation. The tracer wire must be #12 AWG high strength locator wire with a minimum break load of 1150 pounds. Protective coating must be minimum of 45 mil. High Molecular Weight, High Density Polyethylene (HMW-HDPE).

Marking posts must be Rhino TriView™ Marking System post with test station or approved equal. Marking posts and test stations must be supplied at termination of tracer wire locations and must be colored green and have Force

Main labels. The post must be buried per the manufacturer's recommendations. The marking post and test station must be placed at the right-of-way line.

Wire connectors must be watertight and provide for electrical continuity. Connectors must be dielectric silicone filled to seal out moisture and corrosion. Non-Locking, friction fit, or taped connectors are prohibited.

7.02.06 Valve Boxes

Valve boxes shall be Ford Meter Box Company, Inc. B-22 series or approved equal. The box must be provided with a cast iron lid or cover and marked with the word "SEWER". The valve boxes must be designed to withstand heavy traffic.

7.03 INSPECTION

7.03.01 Shop Inspection

All materials furnished by the Contractor are subject, at the discretion of the Owner, to inspection and approval at the Manufacturer's plant. The inspection in the plant of the manufacturer of materials furnished by the Contractor will be made at the expense of the Owner.

7.03.02 Field Inspection

All pipe and accessories must be laid, joined, and tested under pressure for defects and leakage in the manner specified herein and as approved by the Township.

7.03.03 Disposition of Defective Material

All material found during the progress of the work to have cracks, flaws, or other defects will be rejected by the Township. All defective materials furnished by the Contractor must be promptly removed from the site. Any material furnished by the Township and found defective will be set aside and removed from the site of the work by the Township.

7.04 RESPONSIBILITY FOR MATERIAL

7.04.01 Responsibility for Material Furnished by Contractor

The Contractor must be responsible for all material furnished by it and must replace at its own expense all such material found defective in manufacturing or damaged in handling after delivery by the manufacturer. This must include the furnishing of all material and labor required for the replacement of defective or damaged installed material discovered prior to the final acceptance of the work.

7.04.02 Responsibility for Material Furnished by Owner

The Contractor's responsibility for material furnished by the Township will begin

at the point of its delivery to the Contractor. Materials already on the site must become the Contractor's responsibility on the day of the award of the contract. The Contractor must examine all material furnished by the Owner at the time and place of delivery to the Contractor and must reject all defective material. Any material furnished by the Township and installed by the Contractor without discovery of such defects will, if found defective prior to final acceptance of the work, be exchanged for sound material by the Township. The Contractor, however, must at its own expense, furnish all supplies, labor, and facilities necessary to remove said defective material and install the sound material in a manner satisfactory to the Engineer.

7.04.03 Responsibility for Safe Storage

The Contractor must be responsible for the safe storage of material furnished by or to it, and accepted by it, and intended for the work, until it has been incorporated in the completed project. The interior of all pipe, fittings, and other accessories must be kept free from dirt and foreign matter at all times. Valves must be drained and stored in a manner that will protect them from damage by freezing.

7.04.04 Replacement of Damaged Material

Any material furnished by the Township that becomes damaged after acceptance by the Contractor must be replaced by the Contractor at its own expense.

7.05 HANDLING OF MATERIAL

Contractor must use care and proper equipment while unloading and distributing force main materials on the job site to ensure the materials are not damaged.

Pipe and/or fittings must not be rolled or skidded off the truck beds against previously unloaded materials.

7.06 ALIGNMENT AND GRADE

7.06.01 General

The force main must be laid and maintained to the required lines and grades with fittings at the required locations. All force mains must maintain a ten (10) feet horizontal separation and eighteen (18) inch vertical separation from water main.

The Engineer must place line and grade stakes at each fitting and every 100-foot points thereafter to the next fitting or more often, as determined by the Township. The Contractor must check the line and grade at every point at which a stake has been placed and notify the Township where there is a grade discrepancy.

7.06.02 Deviations Occasioned by Other Structures

Whenever obstructions not shown on the drawings are encountered during the progress of the work and interfere to such an extent that an alteration in the

drawings is required, the Township has the authority to change the drawings and order a deviation from the line and grade or arrange with the owner of the structures for the removal, relocation, or reconstruction of the obstructions. If the change in drawings results in a change in the amount of work by the Contractor, such altered work must be done by written order only on the basis of payment to the Contractor for extra work or credit to the owner for less work.

7.06.03 Depth of Pipe

All pipes must be laid so that the top of the pipe has a minimum cover of five (5) feet below existing grade at the force main and six (6) feet when underneath section roads, unless specified otherwise. When elevations and grades are provided on the drawings, the Contractor must install in accordance with those elevations and grades.

7.07 LAYING

7.07.01 Lowering of Force Main Material Into Trench

Proper implements, tools, and facilities must be provided and used by the Contractor for the safe and expedient completion of the work. All pipe and fittings must be carefully lowered into the trench by means of suitable tools or equipment, in such a manner as to prevent damage to force main material and protective coatings and linings. Under no circumstances may force main materials be dropped or dumped into the trench.

If damage occurs to any pipe or fittings in handling, the damage must be immediately brought to the Township's attention. The Township will prescribe corrective repairs or rejection of the damaged items.

7.07.02 Inspection Before Installation

All pipe and fittings must be carefully examined for cracks and other defects while suspended above the trench immediately before installation in final position. Spigot ends must be examined with particular care as this area is the most vulnerable to damage from handling. Defective pipe or fittings must be laid aside for inspection by the Township, who will prescribe corrective repairs or rejection.

7.07.03 Cleaning of Pipe and Fittings

All lumps, blisters, and excess coating must be removed from the bell and spigot ends of each pipe, and the outside of the spigot and the inside of the bell must be wire brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

7.07.04 Laying of Pipe

All dirt or other foreign material must be removed from the inside of the pipe before it is lowered into its position in the trench, and it must be kept clean by approved means during and after laying. No tools or other articles may be stored in the pipe at any time.

For bell and spigot pipe as each length of pipe is placed in the trench, the spigot end must be centered in the bell and the pipe forced home and brought to correct line and grade. For force main construction, the spigot end must be installed in the direction away from the pump station so as to minimize effluent material hanging up on the pipe joints. The pipe must be secured in place with approved backfill material tamped under it except at the bells. Precautions must be taken to prevent dirt from entering the joint space.

At times when pipe laying is not in progress, the open ends of the pipe must be closed by a watertight plug or other means approved by the Township. This provision must apply during the noon hour as well as overnight. If water is in the trench, the seal must remain in place until the trench is pumped completely dry.

7.07.05 Cutting of Pipe

The Contractor must cut the pipe in a straight and uniform manner, at right angles to the axis of the pipe, wherever necessary for placing valves, fittings, or closure pieces without damage to the pipe, and without extra cost to the owner. The cut ends of the pipe must be beveled before assembly of the joint.

The method of cutting pipe will be subject to the approval of the Township.

7.07.06 Locator Wire and Marking Posts

Two (2) 12 AWG insulated copper locator wire must be attached to the force main pipe (regardless of material type) at approximately five (5) foot intervals using tape or other suitable methods to assure that the wire is not dislocated during pipe installation and backfilling. All joints must be soldered and taped or suitably insulated.

The locator wire must be brought to the surface and connected to the marking post and test station with approximately five (5) feet of slack. At air release valve manholes, the locator wire must be brought to the ground surface and attached to a marking post above grade. The marking post and test station must be placed at maximum 1,000' intervals with one testing station located at the beginning and the end of the force main and at the air release structure. Testing stations must be located on the right-of-way line.

Approximate testing station and marking post locations are indicated on the drawings; however, the Contractor must coordinate actual locations of the marking posts and test stations with the Owner and Engineer.

Prior to acceptance of the force main the Contractor must verify the continuity and conductivity of the tracer wire in the presence of the Township. At any areas in which conductivity and/or continuity are compromised, the contractor must excavate, repair, and retest the tracer wire at no cost to the Township. Continuity testing will involve using typical low frequency (512 HZ or similar) line locating equipment.

7.08 JOINING OF MECHANICAL - JOINT PIPE

7.08.01 General Requirements

The general requirement in Sec. 7.03 - 7.07 inclusive must apply except that, where the terms "bell" and "spigot" are there used, they must be considered to refer to the bell and spigot ends of the lengths of mechanical-joint pipe.

7.08.02 Cleaning and Assembly of Joint

The last eight (8) inches outside of the spigot and inside of the bell of mechanical joint pipe must be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter from the joint and then coated with a lubricant as supplied or recommended by the pipe manufacturer and approved by the Township. The retaining gland must then be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket, or bell, end. The rubber gasket must be coated with lubricant and placed on the spigot end with the thick edge toward the gland.

7.08.03 Bolting of Joint

The entire section of the pipe must be pushed forward to seat the spigot end in the bell. The gasket must then be pressed into place within the bell; care must be taken to locate the gasket evenly around the entire joint. The retaining gland must be moved along the pipe into position for bolting, all of the bolts inserted, and the nuts screwed up tightly with the fingers.

All nuts must be tightened with a suitable (preferably torque-limiting) wrench. The torque for various sizes of bolts must conform to ANSI/AWWA C600, Standard for Installation of Ductile-Iron Mains and Their Appurtenances as follows:

<u>Size</u> Inches	<u>Range of Torque</u> Foot – Pounds
5/8	45 – 60
3/4	75 - 90
1	100 - 120
1-1/4	120 – 150

Nuts spaced 180 degrees apart must be tightened alternately in order to produce an equal pressure on all parts of the gland. When tightening bolts, it is essential that

the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This may be done by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side, and last, the remaining bolts. Repeat this cycle until all bolts are within the above range of torques. If effective sealing is not attained at the maximum torque indicated above, the joint should be disassembled and reassembled after thorough cleaning. Over stressing of bolts to compensate for poor installation practice is not allowed. Unless otherwise specified, Mega-lugs as manufactured by EBAA Iron Sales, Inc. or approved equal must be used for restraining gland.

7.08.04 Permissible Deflection in Mechanical-Joint Pipe

Whenever it is desirable to deflect mechanical-joint pipe in order to form a long radius curve, the amount of deflection must not exceed the maximum limits shown in Table 1.

TABLE 1
PERMISSIBLE DEFLECTIONS IN MECHANICAL - JOINT PIPE

Size of Pipe Inches	Max. Permissible Deflection Per Length - Inches		Approx. Radius of Curve Produced By Succession of Joints - Feet	
	18'	20'	18'	20'
3	31	35	125	140
4	31	35	125	140
6	27	30	145	160
8	20	22	195	220
10	20	22	195	220
12	20	22	195	220
14	13.5	15	285	320
16	13.5	15	285	320
18	11	12	340	380
20	11	12	340	380

7.09 JOINING OF PUSH-ON JOINT PIPE

7.09.01 General Requirements

The general requirements in Section 7.03 - 7.07 inclusive must apply except that, where the terms "bell" and "spigot" are there used, they must be considered to refer to the bell and spigot ends of the lengths of push-on joint pipe.

7.09.02 Cleaning and Assembly of Joint

The inside of the bell and the outside of the spigot end must be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter. The circular rubber gasket must be flexed inward and inserted in the gasket recess of the bell socket.

A thin film of gasket lubricant must be applied to either the inside surface of the gasket or the spigot end of the pipe or both. Gasket lubricant must be as supplied or recommended by the pipe manufacturer and approved by the Township.

The spigot end of the pipe must be centered in the bell and forced or pushed home. Smaller sizes of pipe can be pushed or forced into place by hand; larger sizes will require the use of mechanical assistance.

The condition of the trench bottom must be such that location and position of the pipe to be joined is in a straight line assuring a joint of maximum tightness and permanent seal.

7.09.03 Permissible Deflection in Push-On Joint Pipe

Whenever it is desirable to deflect push-on joint pipe, in order to form a long radius curve, the amount of deflection must not exceed the maximum limits shown in Table 2, unless recommended by the pipe manufacturer and approved by the Township.

TABLE 2
PERMISSIBLE DEFLECTIONS IN PUSH-ON JOINT PIPE

Size of Pipe Inches	Max. Permissible Deflection Per Length - Inches		Approx. Radius of Curve Produced By Succession of Joints - Feet	
	18'	20'	18'	20'
3	19	21	205	230
4	19	21	205	230
6	19	21	205	230
8	19	21	205	230
10	19	21	205	230
12	19	21	205	230
14	11	12	340	380
16	11	12	340	380
18	11	12	340	380
20	11	12	340	380

7.10 JOINING HDPE PIPE

7.10.01 Butt Fusion

Sections of polyethylene pipe must be joined into continuous lengths on the jobsite above ground when possible. The joining method must be the butt fusion method and must be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures must be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 - 450 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining must produce a joint weld strength equal to or greater than the tensile strength of the pipe itself.

Qualifications of the fusion technician must be demonstrated by evidence of electrofusion training within the past year on the equipment to be utilized for this project.

7.10.02 Sidewall Fusion

Sidewall fusions for connections to outlet piping must be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion must have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron must be 1/4 inch larger than the size of the outlet branch being fused.

The qualifications of the fusion technician must be demonstrated by evidence of electrofusion training within the past year on the equipment to be utilized for this project.

7.10.03 Mechanical

Bolted joining may be used when connecting to other pipe materials. Flange joining must be accomplished by using a HDPE flange adapter with a ductile iron back-up ring. Mechanical joint joining must be accomplished with a molded mechanical joint adapter with a ductile iron mechanical joint gland.

7.10.04 Electrofusion

At locations shown on drawings or approved by the engineer, electrofusion sleeves may be allowed where butt fusion is not possible.

Electrofusion joining must be done in accordance with the manufacturers recommended procedure and ASTM F 1290 and PPI TN 34. The electrofusion processor must be capable of reading and storing the input parameters and the fusion results for later download to a record file.

The qualifications of the fusion technician must be demonstrated by evidence of electrofusion training within the past year on the equipment to be utilized for this project.

7.10.05 Other

Socket fusion, hot gas fusion, threading, solvents, and epoxies may not be used to join HDPE pipe.

7.11 ANCHORAGE

7.11.01 Restrained Joint Pipe – Ductile Iron

The use of restrained joint pipe must be approved by the Township. If approved, all ductile iron restrained joint pipe must be McWane Ductile “TR Flex”; American Ductile Iron Pipe “Lok-Ring Joint” or “Flex-Ring Joint”; or approved equal. All components of the restrained joint must be as manufactured, supplied, or recommended by the manufacturer of the restrained joint pipe system actually installed.

7.11.02 Joint Restraint Devices – Ductile Iron and PVC

Joint restraining glands must be EBAA Iron Sales “Megalug”, Ford “Uniflange Series 1400”, Tyler Union “Tuf-Grip Series 1000” or approved equal. Joint restraining glands must not be used to provide restraint to plain end fittings.

For ANSI/AWWA C900 pipe, the EBAA Iron Inc. Series 2000PV Mechanical Joint Restraint. For ANSI/AWWA C909 PVC pipe, the EBAA Iron Inc. Series 19MJG00 Mechanical Joint Restraint must be used. For ANSI/AWWA C900 and C909 in line pipe restraint, restraint must be the EBAA Iron Inc. Series 1900 Restraint Harness or approved equal

7.11.03 Anchorage for Plugs, Caps, Tees, Bends, and Valves – Ductile Iron and PVC

Unless otherwise specified or approved by the Engineer, movement of all plugs, caps, tees, bends, and valves must be prevented by use of restrained joint pipe or joint restraining glands. When joints are to be restrained with mechanical devices as noted above, all joints must be restrained for a minimum distance from the fitting as required in the following Table 3 (pipes larger than 20-inch must have restraint as shown on the drawings).

The use of joint restraining glands to provide restraint to plain end fittings is not an acceptable means of restraint and will not be allowed.

TABLE 3
PIPE RESTRAINT LENGTH REQUIRED, FEET

Pipe Diameter	Tees, 90° Bends	45° Bends	22-1/2° Bends	11-1/4° Bends	Dead Ends	Reducers (one size)	**
4"	33	13	7	3	82		
6"	46	19	9	4	117	61	90
8"	59	24	11	6	149	61	79
12"	83	34	17	9	213	114	172
16"	106	44	21	10	275	117	157
20"	127	53	26	13	333	117	149

****If straight run of pipe on small side of reducer exceeds this value, then no restrained joints are necessary.**

NOTE: The length of restrained joint pipe required as shown in the table above is based on trench backfill being compacted to 95% of maximum unit weight in accordance with MDOT procedures.

All joints lying within the above minimum distances from the fitting must be restrained as noted herein.

Tees: Tees must be restrained in the branch direction as required in the table above. Also, to augment the above, in the straight through direction, the minimum length of the first pipe on either side of the tee must be ten (10) feet.

Bends: Bends must be restrained in both directions as required in the table above.

Valves: Valves used in conjunction with restrained joint pipe must be restrained in accordance with the recommendations of the manufacturer of the restrained joint pipe. All valves at crosses or tees must be restrained to the tee by use of restrained joint pipe or joint restraining glands as specified above.

Unstable Soils: Secure all fittings with restrained joint pipe or joint restraining glands throughout entire area of muck plus an additional length beyond the muck area in suitable soils for a distance in accordance with this section.

7.11.04 Reaction Backing (Thrust Blocks) – Ductile Iron and PVC

Reaction backing (thrust blocks) must be used only at locations indicated on the drawings or approved by the Township.

Reaction backing must be poured-in-place concrete having a compressive strength of not less than 2,000 psi after twenty-eight (28) days. Backing must be placed between solid, undisturbed ground and the fitting to be anchored. The area of bearing on the pipe and on the ground in each instance must be that shown in the

table below or directed by the Township. The backing must, unless otherwise shown or directed, be so placed that the pipe and fitting joints will be accessible for repair. Concrete must not be allowed to be placed around joint restraint devices. If concrete will be placed around fittings the fittings and joints must be wrapped in polyethylene encasement per section 7.02.01.04.

Minimum Bearing Area against undisturbed trench wall, in square feet, for sand is indicated in Table 4 below. Details of placement are shown in Standard Details.

TABLE 4
REACTION BACKING

Pipe Size	Tees, Plugs, Wyes, 45° Els	90° Els	Wyes, 22-1/2° Els or Less
6"	3	3	1
8"	4	6	2
10"	7	9	3
12"	9	11	3
16"	13	20	6
20"	20	28	8

Other Soil Conditions

Cement Sand or Hardpan	-	multiply above by 0.5
Gravel	-	multiply above by 0.7
Hard Dry Clay	-	multiply above by 0.7
Soft Clay	-	multiply above by 2.0

Muck – secure all fittings with restrained joint pipe or joint restraining glands, with concrete reaction backing the same as listed for sand conditions.

7.11.05

Restraint Collars – HDPE

HDPE pipe must have restraint collar(s) as shown in the locations and as detailed on the drawings. Restraint collars or restraining flanges may be required at locations where HDPE pipe connects to other pipe or when connecting to a manhole.

To limit the range of thermal expansion or contraction, HDPE force main must be in place and backfilled a minimum of 72 hours prior to installation of pipe restraint and connections to other pipes.

After the concrete collar has cured a minimum of 12-hours, Contractor must install compacted sand backfill around collar.

7.12 CLEAN OUTS

Single clean outs must be constructed as shown on the standard detail or shown on the drawings. All pipe and fittings for the clean out must match the force main pipe, unless otherwise specified.

Unless otherwise specified, manhole castings must be EJ No. 1040 with Type A solid cover or approved equal.

7.13 AIR RELEASE/VACUUM RELIEF VALVES

7.13.01 Air Release/Vacuum Relief Valve

Air release/vacuum relief valves must be as specified in the Project Specifications and/or approved by the Township with inlet, outlet, and orifice sizes as specified. Riser and fittings to be stainless steel; valves to be ¼ turn stainless steel ball valves. Location of air release valve must be shown on the construction drawings.

7.13.02 Air Release/Vacuum Relief Valve Manhole

Air release/Vacuum Relief valve manholes must be constructed in accordance with the Standard Details and as specified herein.

Precast bases must be installed on the subbase in such a way as to provide a uniform bearing under the manhole base.

Precast manholes with integral bottom may be used; however, any changes to the structure due to minor field adjustments in alignment and grade required to meet construction conditions, must be made by the Contractor at no additional cost to the Township.

Vented castings must be EJ No. 1045 with Type B vented cover or approved equal.

Unless otherwise specified, manhole steps must be plastic coated steel steps conforming to the requirements of ASTM Designation C478, or approved equal, spaced at 16" on center. Steps shall be aligned perpendicular to the existing force main.

7.13.03 Flexible Manhole Connectors (Rubber Boots)

Flexible manhole connectors (also called rubber boots) must be "Kor-N-Seal" by National Pollution Control Systems, Inc., "P.S.X." or "Press Wedge II" by Press Seal Gasket Corporation, "Lock Joint Flexible Manhole Sleeve" by Inter Pace Corporation, "A-LOK," "Z-LOK," or "QUIK-LOK" by A-LOK Products, Inc. or approved equal. Flexible manhole connectors must conform to the requirements of ASTM Designation C923, Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

7.14 HYDROSTATIC TESTS

7.14.01 Procedure

All tests must be made by the Contractor using its own equipment, operators, and supervision, in the presence of the Engineer or its duly authorized representative. The length of the section to be tested must be as approved by the Engineer, or as shown on the drawings.

Contractor may coordinate with the Township to use water. The Township may have a meter fee and other fees for water usage that will be billed to the Contractor actor will be billed for the difference after total water use has been determined.

The Contractor must provide their own Reduced Pressure Zone (RPZ) Backflow Preventer as approved by the Township. Temporary fittings needed for testing, the meter supply fee, and the water usage fee must be included in the major items of work and will not be paid for separately.

7.14.02 Air Removal Before Test

Before applying the specified test pressure, all air must be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor must install corporation cocks at such points so the air can be expelled as the line is filled with potable water. After all the air has been expelled, the corporation cocks must be closed and the test procedure may begin.

7.14.03 Hydrostatic Test – Ductile Iron

A leakage test must be conducted during the hydrostatic pressure test in the presence of the Township. The Contractor must furnish the pump, pipe, connections, gages, and all other necessary apparatus, and must furnish the necessary assistance to conduct the test. The duration of the leakage test must be a minimum of two (2) hours and during the test the main must be subjected to a pressure of 150 psi. When several valved sections are tested as one test, the maximum allowable leakage will be equivalent to the calculated allowable leakage for the smallest valved section therein.

Leakage must be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain the specified leakage test pressure after the air in the pipeline has been expelled, and the pipe has been filled with water. No pipe installation will be accepted if the leakage is greater than that determined by the formula:

$$L = \frac{SD\sqrt{P}}{148,000}$$

Where:

L = Allowable leakage in gallons per hour

S = Length of pipe tested, in feet

D = Nominal diameter of the pipe, in inches

P = Average test pressure during the leakage test, in pounds per square inch gauge.

This formula is based on allowable leakage of 10.49 gallons per day, per mile of pipe, per inch of nominal diameter at 150 psi.

The Township will furnish a written report of the results of the leakage test that identifies the specific length of pipe tested, the pressure, the duration of the test, and the amount of leakage.

7.14.04 Hydrostatic Test – HDPE Pipe

The hydrostatic test procedure for HDPE pipe must conform to ASTM F2164. Testing must be performed with the pipe in the trench following backfill placement. Subject the lowest element in the system to a test pressure that is 1.5 times the design pressure or a minimum of 100 psi, whichever is greater, and check for any leakage.

The test procedures consist of two steps; the initial expansion and the test phase. When test pressure is applied to a water-filled pipe, the pipe expands. During the initial expansion of the pipe under test, sufficient make-up water must be added to the system as needed for up to four (4) hours to maintain the test pressure. After four (4) hours, initial expansion should be complete and the actual test can start.

After four (4) hours of maintaining pressure as described above, the pressure must then be dropped by 10 psi. At this point do not increase pressure or add make-up water. If the pressure then remains within five (5%) percent of the target value for one (1) hour, this indicates there is no leakage in the system.

Note: Under no circumstances must the total time under test exceed eight (8) hours at 1 ½ times the system pressure rating. If the test is not complete within this time limit (due to leakage, equipment failure, etc.), the test section must be permitted to “relax” for eight (8) hours prior to the next test sequence.

7.14.05 Variation from Permissible Leakage or Pressure Loss

If any test of pipe laid discloses leakage or pressure loss greater than that specified above, the Contractor must at its own expense locate and repair the leaks until the leakage or pressure drop is within the specified allowance. All visible leaks must be repaired regardless of the allowance used for testing.

7.14.06 Time for Making Test

The pipe may be subject to hydrostatic pressure and inspected and tested for leakage at any convenient time after the trench has been partially backfilled. Where any section of the main is provided with concrete reaction backing or restraint blocks, the hydrostatic pressure test must not be made until at least seven (7) days have lapsed after the concrete was installed. If high-early-strength cement is used, the hydrostatic pressure test must not be made until at least two (2) days have elapsed.

7.15 RECORD DRAWINGS

See Sections 1.06, 1.08, and 1.12.07 for more information on record drawing submittal requirements. Below are the individual requirements for record drawings for all sanitary force main construction. Records from the Contractor must be provided every Friday to the Township.

7.15.01 Connection to Existing Sanitary Sewer or Force Main

Details will be required for connecting into the existing sanitary sewer or for connecting into an existing force main.

7.15.02 Force Mains and Structures

Type of pipe and a list of materials must be reported on the record drawings. Clearances between utilities must also be reported on the record drawings. Length of the main structure to structure must be required on the record drawings.

Cleanout, air release/vacuum relief manholes, and valve boxes must be witnessed to three (3) permanent surface features. Type of valve in the air release/vacuum relief structure must also be noted on the record drawings.

7.16 MEASUREMENT AND PAYMENT

7.16.01 General

All proposed construction will be measured for payment by the Township in accordance with the items listed in the proposal.

The unit price bid for each Proposal item will be payment in full for completing the work, ready for use as specified.

7.16.02 Force Main

Measurement of the length of the main will be in feet along the centerline of the force main and will include any joint restraint or polyethylene encasement required. Payment of tracer wire furnishing, installation, and testing must be included in the Force Main item.

7.16.03

Fittings

When a specific item is provided in the Proposal for Bends, Tees, Reducers, Adaptors and/or Wyes, the unit price bid must be the additional cost of furnishing and placing the fitting over and above the cost of furnishing and laying the force main and must include any joint restraint required.

When no proposal item is provided, the work must be incidental to the major items of work.

7.16.04

Clean-Outs

When a specific item is provided in the proposal for Cleanout and Chamber, the unit price bid will be the additional cost of furnishing and placing the required fittings and will include the furnishing and installing the precast manhole in accordance with the standard detail.

When no proposal item is provided, the work must be incidental to the major items of work.

7.16.05

Air Release/Vacuum Relief Valves

Air Release/Vacuum Relief Valve and Chamber will be paid for in accordance with the units established in the proposal and will include the furnishing and installing the precast manhole in accordance with the standard detail.

7.16.06

Valves

Valves will be measured as single units and shall include valve box, joint restraint, and other materials as required for installation of the valve and valve box.

7.15.07

Thrust Blocks and Restraint Collars

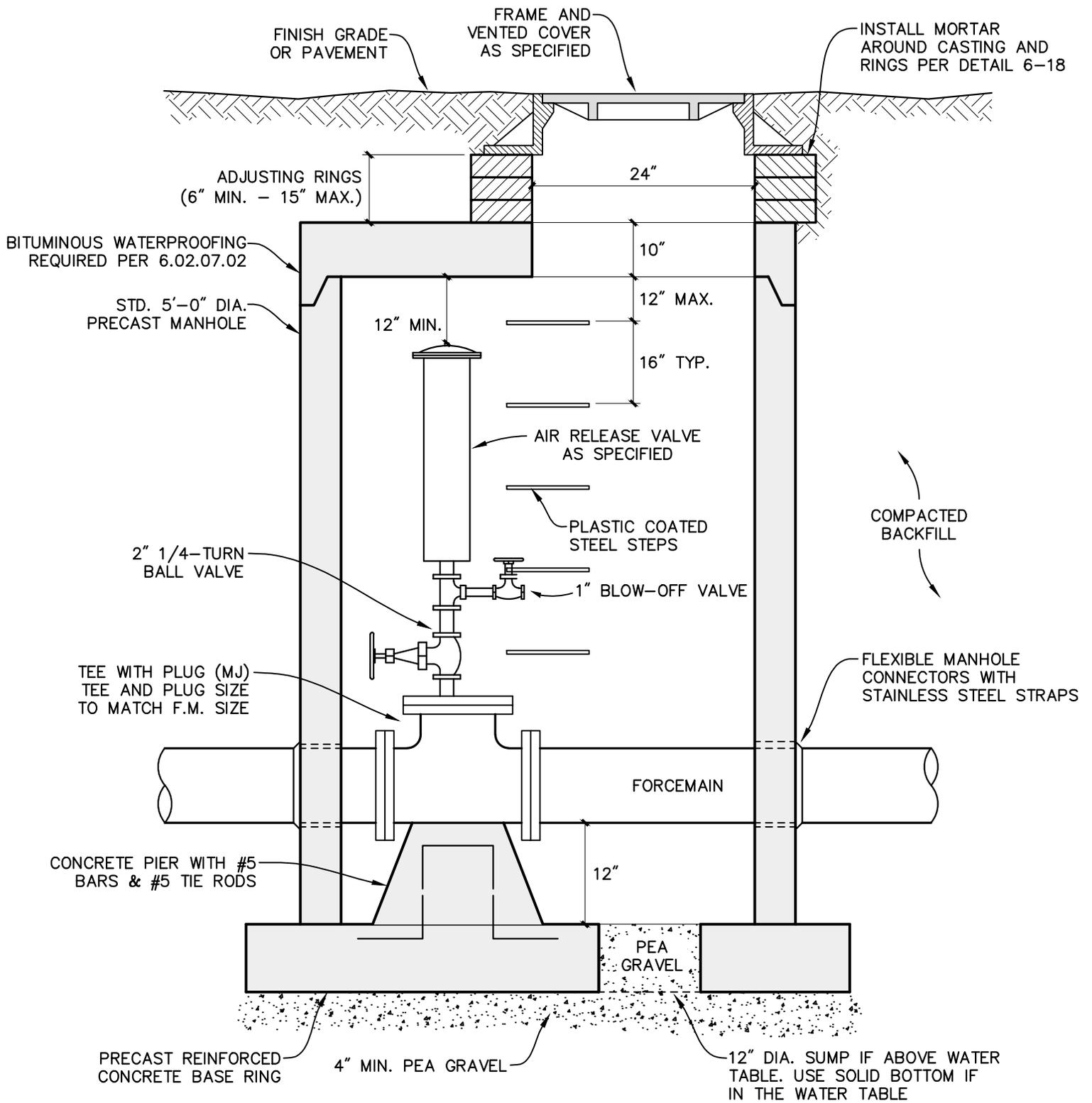
Thrust blocks and Restraint Collars will be measured as single units and must include all concrete, steel reinforcement, wall anchors or restraint fins, and labor.

When no proposal item is provided, the work must be considered part of the major items of work.

7.15.08

Locator Wire and Marking Posts

Locator wire will be considered included in the cost of the force main pipe. Marking Post and Test Station will be paid per the unit installed and will include tracer wire connection to the test station and the installation of a ground rod per the manufacturer's recommendations.

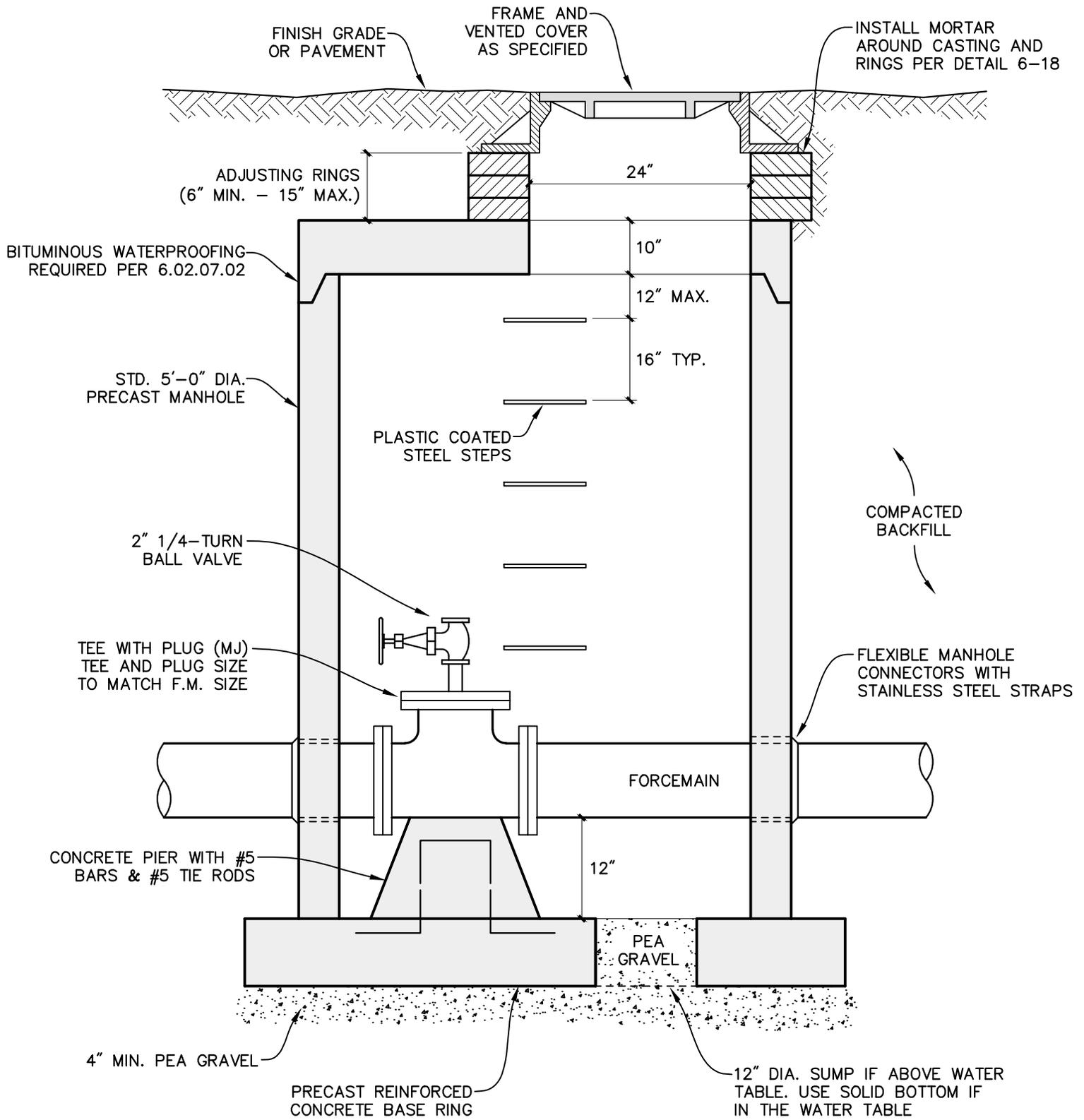


STANDARD AIR RELEASE VALVE MANHOLE

SCALE : NONE

NOTE

1. PRECAST CONCRETE MANHOLE SHALL MEET ASTM C478.
2. INSTALL AIR RELEASE VALVE AT THE VERY HIGHEST ELEVATION OF THE FORCE MAIN.
3. SET ON MINIMUM 4" PEA GRAVEL (CIP) WRAPPED IN GEOTEXTILE FABRIC.

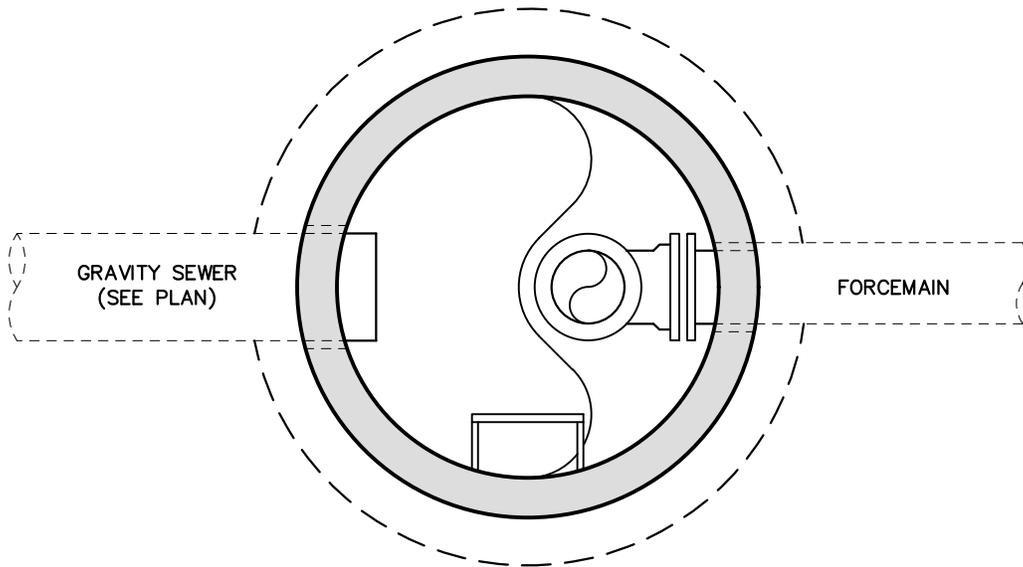


STANDARD CLEANOUT MANHOLE

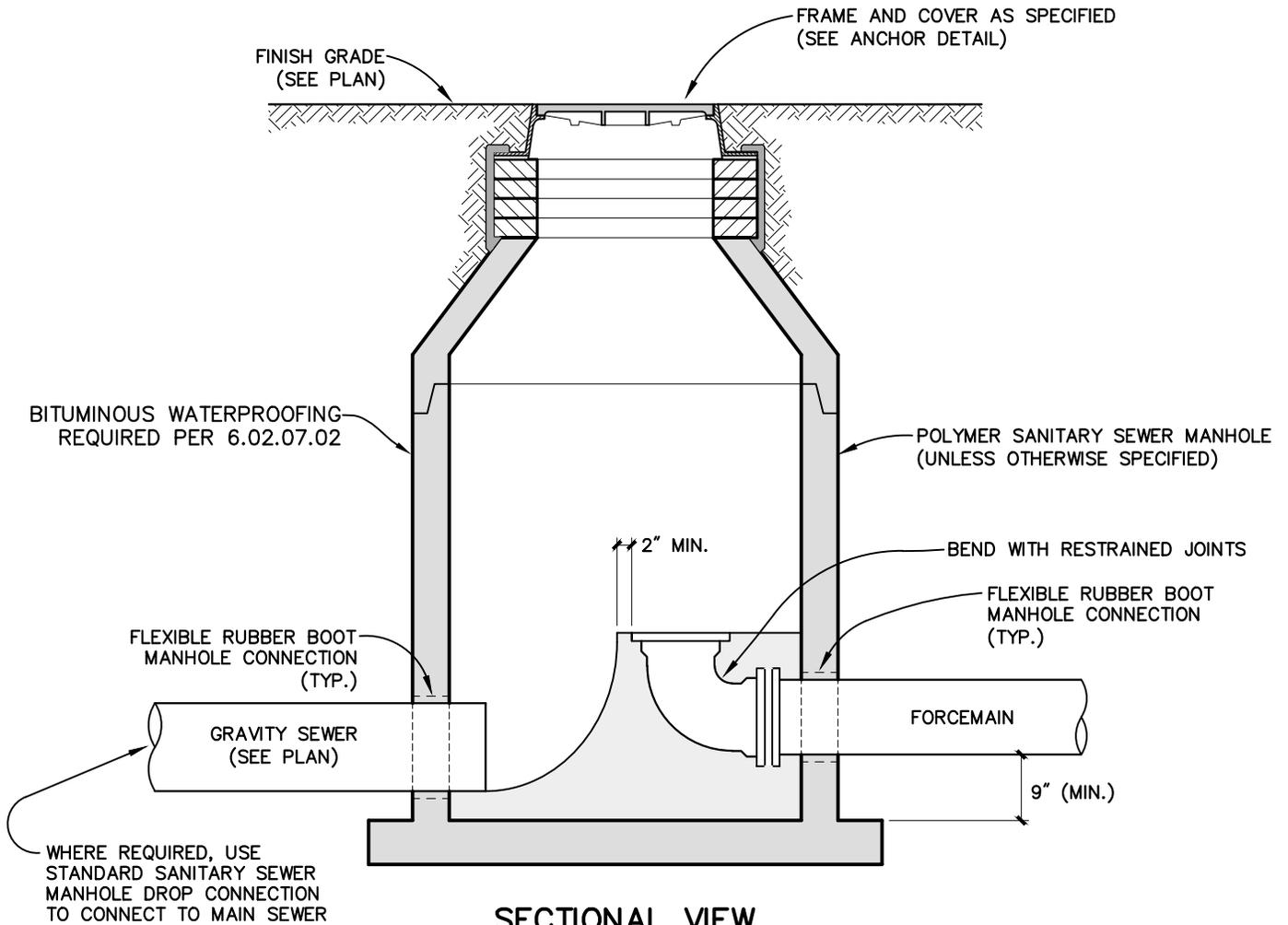
SCALE : NONE

NOTE

1. PRECAST CONCRETE MANHOLE SHALL MEET ASTM C478.



PLAN VIEW



SECTIONAL VIEW

STANDARD FORCE MAIN DISCHARGE MANHOLE

SCALE : NONE