

Revised 5-27-08

**WATER DISTRIBUTION SYSTEM
SPECIFICATIONS**

**JEFFERSON COUNTY PUBLIC SEWER DISTRICT
P.O. BOX 632
HILLSBORO, MISSOURI 63050**

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SECTION 1 - WATER DISTRIBUTION SYSTEM MATERIALS

1. GENERAL

Materials for use at any location in the water distribution system shall meet the requirements as set forth in the following Articles under this Section. Where references are made to standards such as AWWA, ANSI, ASTM, etc. it shall be understood that such references are to the latest edition of such standards. When requested by the District, Contractors shall furnish affidavits from their suppliers certifying that materials conform to stated standards before being incorporated into the work.

Where materials are specified by brand name and model, followed by the words "or approved equal", the information concerning an "approved equal" product must be submitted to the District and a written statement of approval by the District must be issued by the District before such material may be used. In all cases, approval of such alternate products shall be at the sole discretion of the District.

Failure to comply with these specifications shall result in rejection of the work by the District.

2. PIPE

All pipe for water mains shall be 6" (inch) in diameter or larger and shall be PVC or ductile iron. In general pipes 6", 8" and 12" in size shall be PVC and pipes larger than 12" shall be ductile iron. For certain projects, 12" pipe may be required to be ductile iron. No 10", 14" or 18" pipe will be allowed except as required to connect to existing facilities.

PVC pipe shall be class 200, with a standard dimension ratio (SDR) of 21 or as otherwise directed by the District. Pipe for use under this heading shall be manufactured from clean, virgin, N.S.F. approved Type I, Grade I, 1120 P.V.C. conforming to A.S.T.M. specification D2241. The pipe shall be pressure rated for a hydrostatic working pressure of 200 PSI at 73.4 degrees F. and shall meet all applicable requirements as set forth under Commercial Standard (CS) 256-63. The pipe shall also conform to the following tests conducted at 73.4 degrees F:

a. Hydrostatic Integrity: The pipe shall withstand without failure, a pressure of 420 PSI. for at least 1,000 hours, in accordance with A.S.T.M. Specifications 1598-63T. The pipe shall withstand without failure, a pressure of 630 PSI. applied in 60 to 90 seconds in accordance with Specification 2599-62T.

b. Vice Flattening Test: A 2 inch wide section of pipe shall be flattened in less than one minute, to 100% without showing evidence of shattering or splitting at 73.4 degrees F.

c. Pipe Wall Thickness: Rigid plastic pipe shall be manufactured to provide a minimum pipe wall, and bell or coupling thickness in accordance with the following schedules:

Minimum Wall Thickness (Inches)		
I.D. Size (inches)	Barrel	Bell

2	.113	.146
4	.214	.258
6	.316	.376
8	.410	.481
10	.511	.607
11	.606	.735

Concentricity: The outer diameter of the pipe shall be concentric within .003 of an inch.

All PVC pipe shall be joined by means of a rubber ring slip joint. Cement weld or glued joints will not be permitted. The slip joint shall be formed by a bell joint that shall be an integral and homogenous part of the pipe formed by extrusion, with a ring groove for seating the rubber ring gasket. "Ultra Blue" or other PVC with any thickness less than stated above will not be allowed. Also, -900 PVC pipe will not be allowed.

Ductile Iron pipe shall conform to AWWA C-151 and be cement lined and seal coated in accordance with AWWA C-104. The joints shall be push on type with rubber gaskets conforming to AWWA C-111. In general, ductile iron pipe shall be pressure Class 250 with Class 50 wall thickness. For all pipe placed in casing pipe under roads or highways, where used for creek or ditch crossings or at any location requiring vertical fittings with concrete encasement or thrust blocking, the pipe shall be ductile iron, pressure Class 350 with Class 52 wall thicknesses.

3. FITTINGS

All fittings shall be ductile iron, Class 350, conforming to AWWA C-153. The fittings shall have mechanical joints conforming to AWWA C-111 and be cement lined and seal coated in accordance with AWWA C-104. If restraints are being used in a ductile iron restraint system for pipe 16" and larger, slip joint fittings with TR FLEX, Flex Ring or Super Lock joints may be used. Slip joint fittings with Field Lok gaskets will not be allowed.

4. VALVES

Valves for 6", 8" and 12" pipe shall be gate valves. Valves for 16" pipe and larger shall be butterfly valves. All gate valves shall be ductile iron or cast iron, resilient wedge valves, with non-rising stems, 2" operating nuts, mechanical joints and epoxy coated bodies and be manufactured in accordance with AWWA Standard C-509. The wall thickness for ductile iron valves shall meet or exceed AWWA Standard C-153. The valves shall be designed to withstand a working pressure of 250 PSI on either side of the valve. The valves shall be American Flow Control Model AFC-2500, U.S. Pipe Metroseal 250, Tyler Class 250, Mueller A-2360 or approved equal.

The valves shall open counterclockwise and have the maker's initials, pressure rating, and year in which manufactured cast on the body. Where valves are set at a depth that leaves the operating nut more than four (4) feet below the proposed grade, an extension stem shall be furnished to bring the operating nut to within two (2) feet of the

proposed grade.

Butterfly valves shall conform to AWWA C-504 for Class 150B butterfly valves. All butterfly valves shall have a working pressure of 200 PSI. All valve components shall conform to Underwriters Laboratories classification in accordance with ANSI/NSF

21.11.

Butterfly valves shall have cast iron or ductile iron bodies, be designed for buried service, have mechanical joint ends and have side mounted 2" square operating nuts suitable for use in a standard valve box as stated herein for gate valves.

Discs shall be offset to provide an uninterrupted 360 seating edge and shall be ductile iron per ASTM A48, Class 40C. The disc seating edge shall be solid 316 stainless steel. Sprayed mating seating surfaces are not acceptable. The disc shall be securely attached to the valve shaft utilizing a field removable/replaceable 316 stainless steel torque screw on sizes 6" – 12" or a tangential pin locked in place with a set screw on sizes above 12".

The valves shafts shall be type 304 stainless steel. Valve seals shall be self-compensating V-type packing with a minimum of four sealing rings. One piece molded shaft seals and O-ring shaft seals will not be allowed.

The seats shall be of Buna-N for water and shall be molded in and vulcanized to the valve bodies. The seats shall contain integral shafts seals protecting the valve bearings and packing from any line debris. Seats vulcanized to cartridge inserts in the valve bodies and seats on the discs are not allowed. Valve shaft bearings shall be non-metallic and permanently lubricated.

The exterior and interior of metallic surfaces of each valve shall be shop painted per AWWA C504. The interior of the bodies shall have a full rubber lining vulcanized to the valve bodies.

Each valve operator shall be sized to operate the valve at the rated working conditions of the valve. Each valve shall be assembled, adjusted, and tested as a unit per AWWA C504, by the valve manufacturer. The test pressure for leakage tests shall be 225 PSI.

5. VALVE BOXES

All buried valves shall be provided with a Buffalo type valve box, Tyler 562-S or 564-S, or approved equal. The tops of the valve boxes shall be designed with grooves to accommodate a valve box adjusting tool as provided in the tops of the above referenced Tyler valve boxes. The valve boxes shall be furnished complete with extension pieces where necessary and the top of the box shall be flush with the finished grade or pavement surface. All valve boxes shall have a 1/2 " diameter hole field drilled 3" from the top to accommodate the water main locator wires.

6. CONCRETE FOR THRUST BLOCKING

Concrete for thrust blocking shall be ready mix concrete, composed of Portland cement, sand and gravel with not more than six (6) gallons of water per sack of cement. The concrete shall be a 5-1/2 sack mix with 28 day minimum compressive strength of 3,000 PSI.

7. BEDDING MATERIAL

Bedding material for all PVC pipe and where required for ductile iron pipe shall be crushed limestone and screenings, 3/4" minus.

8. WATER MAIN TRACER TAPE

Water main tracer tape shall be installed with all water mains. The materials to be installed for this purpose shall consist of three (3) inch wide tape made of bonded layer plastic with a metallic foil core. Tape splices shall be knotted to prevent tensile pressure on the splice. The material to be used for this service shall be "Terra Tape D" as manufactured by the Griffolyn Company of Houston, Texas, or approved equal. The metallic tape shall be colored to contrast with the soil and shall bear an imprint identifying the line below, such as; "Caution, Water Main Buried Below".

9. WATER MAIN LOCATER WIRE

For all water mains, PVC and ductile iron pipe, a locator wire shall be provided as specified in Section II of these specifications. The locator wire shall be a single insulated No. 12 copper wire, THNN or THWN, gasoline and oil resistant. The insulated wire shall be furnished in rolls of not less that 500 feet, where splices are required, all splices shall be made with 3M splice kits. No other type of splicing will be allowed.

10. TAPPING SLEEVES AND VALVES

All tapping sleeves for 12" and smaller pipe shall be stainless steel with stainless steel flanges. The tapping sleeves shall be Power Seal No. 3490 AS, Smith Blair 665 or JCM 432, or approved equal, with class 125 ANSI B-16.1 flanges on the outlets. For 12" ductile iron pipes, Smith Blair 662 or other approved 4 bolt models may be used. For pipes larger than 12", the tapping sleeves shall be ductile iron, split mechanical joint type.

Tapping valves shall be designed for leak tight attachment to the tapping sleeve and tapping machine, shall have mechanical joint x flanged joint ends and shall otherwise conform to Section "I-4 Gate Valves" of these specifications. All tapping valves shall have a valve box conforming to "I-5 Valve Boxes" of these specifications.

11. CASING PIPES

Casing pipes for road and highway crossings shall be welded steel pipe with a minimum wall thickness of 1/4", unpainted or coated, and shall have a minimum diameter as shown below and the ends of casing pipes shall be sealed with pre-formed seals or other material approved by the District. Casing pipes shall be sized and have wall thicknesses as shown in the table below.

DI Carrier	Welded Steel Casing Pipe	Pipe Casing Pipe Thickness
6"	16"	0.25"
8"	20"	0.25"
12"	24"	0.375"
16"	30"	0.375"
20"	30"	0.375"

24"	36"	0.375"
30"	42"	0.375"
36"	54"	0.05"
42"	60"	0.5"

12. PIPE SPACERS IN CASING PIPES

Wherever water mains are installed in casing pipes, the ductile iron pipe shall be supported with "RACI" type spacers at 6' intervals, or 3 spacers per 20' length of pipe. The spacers shall be carefully installed on the pipe before it is installed in the casing pipe.

13. FIRE HYDRANTS

Fire hydrants shall have a 5-1/4" valve opening, one 4-1/2" steamer nozzle and two 2-1/2" hose nozzles and a 6" mechanical joint shoe. The fire hydrants shall be Mueller Figure A-423, American Darling No. B-84-B, U.S Pipe or Kennedy K81D, delivered to the site coated with a black bituminous coating for the portions to be underground and a primer and yellow finish coat for the portions to be exposed. The types of paint and coating shall be as recommended by the fire hydrant manufacturer. All hydrants shall receive a final paint coat in the field. Exposed barrels and tops shall be chrome yellow. All hydrant cap threads shall be field-lubricated with an approved, food-grade grease. The hydrants shall have a minimum "bury" of four (4) feet unless the depth of the main requires a deeper "bury". Refer to Detail B of these specifications.

14. POLYETHYLENE ENCASEMENT FOR DUCTILE IRON PIPE

Polyethylene encasement shall be applied to underground installations of ductile iron pipe, fittings, valves and other appurtenances.

Polyethylene film shall be manufactured of virgin polyethylene material conforming to the following requirements of A.S.T.M. Standard Specification D-1248-78 for Polyethylene Plastics Molding and Extrusion Materials:

Raw material used to manufacture polyethylene film :

Type: I

Class: A (natural) or B (black)

Grade: E-I

Flow rate: 0.4 maximum

Dielectric strength: Volume resistivity, minimum ohm-cm(3)=10 (15)

Polyethylene film:

Tensile strength: 1200 psi (8.3 MPa) minimum

Elongation: 300 percent minimum

Dielectric strength: 800 V/mil. (31.5 um) thickness minimum

Thickness:

Polyethylene film shall have a minimum thickness of 0.008 in. (8 mil. or 200 um). The minus tolerance on thickness shall not

exceed 10 percent of the nominal thickness.

Tube size or sheet width:

Tube size or sheet width for each pipe diameter shall be as listed below.

Nominal Pipe Diameter (in)	Minimum Polyethylene Width in (cm)	
	Flat Tube	Sheet
4	16 (41)	32 (82)
6	20 (51)	40 (102)
8	24 (61)	48 (122)
10	27 (69)	54 (137)
12	30 (76)	60 (152)
14	34 (86)	68 (172)
16	37 (94)	74 (188)
24	41 (104)	82 (208)

15. AIR RELEASE DEVICES

For high points in 12” and smaller mains, manual air release devices as shown on Detail E of these Specifications shall be provided. For high points in mains larger than 12”, automatic air release valves shall be provided and such valves shall be Combination Air Valves for Waterworks Service in accordance with AWWA C512. The valves shall be in concrete vaults, 60” in diameter, with cover, air vent, isolation valve and pressure gauges all as designed by the Developer’s Engineer and approved by the District.

16. MAIN LINE PRESSURE REDUCING VALVES

Where a main line pressure reducing valve is required, it shall consist of an underground package pressure reducing station as manufactured by Engineered Fluid, Inc., Centralia, Illinois, or approved equal. The primary pressure reducing valve shall be sized as required by the District Engineer. The pipeline on each side of the pressure reducing station shall have a gate valve installed within 10-20 feet from the pressure reducing station such that the entire pressure reducing station can be shut down without taking any customers out of service.

The station shall be an underground steel capsule, 7’-0” minimum outside diameter with a minimum inside height of 6’-6”. The station shall have a rectangular access hatch 30” X 36” with a Bilco Model MS-50 roof scuttle made of 11 gauge aluminum. The scuttle cover shall have 1” of fiberglass insulation protected by an 18 gauge aluminum liner. The entry lock on the access hatch shall be the pin tumbler, dead bolt type with a safety release, all as shown in Bilco Drawing 6184. Two keys shall be provided, and the locks shall be “keyed alike” such that they may be operated with all other locks on similar PRV stations in the District.

The top and bottom plates shall be lap welded to the capsule and the joints of all steel components shall be lap welded. The capsule shall be reinforced by channels and angles and be provided with lifting plates. The station shall be installed and bolted to an 8" thick reinforced concrete pad. The top of the access hatch shall be 11" above finished grade.

An aluminum access ladder shall be provided which meets UL and OSHA qualifications under Type I, Heavy Duty Specifications. The ladder shall be bolted into place and be removable to allow equipment maintenance. The capsule shall be provided with an 18" diameter, 8" deep sump. The capsule working area shall be covered with a rigid, neoprene floor mat. Pipe supports shall be provided inside the capsule as needed for the support of the equipment. No lighting or other electrical equipment will be required inside the capsule.

All surfaces of the entire structure shall be sandblasted (SSPC – SP6) and coated with Tnemec Series 66 Hi-Build Epoxyline, applied in two applications to a total dry film thickness of 8.0 mils. Two 17 pound package magnesium anodes shall be provided, buried and attached by heavy copper wire to lugs provided for that purpose.

The main line pipeline through the capsule shall have a normally closed isolation valve and a compression coupling or flanged coupling adapter to allow removal of the isolation valve. The primary pressure reducing valve shall be located in a by pass loop, the same size as the main line. The loop shall contain, in addition to the primary pressure reducing valve, two isolation valves and a compression coupling or flanged coupling adapter to allow removal of the equipment. All isolation valves shall be rated at 250 PSI working pressure. There shall also be provided a 3" loop with the secondary pressure reducing valve (3"), two 3" isolation valves and a coupling for the removal of equipment. All piping shall be schedule 40 steel with flanged ends except that the 3" piping and fittings shall be stainless steel. All flanges shall be drilled to match Class 125 ANSI B16.1 flanges. Where the pipes pass through the capsule wall, they shall be fully welded along the circumference on both sides of the capsule wall.

A pressure gauge shall be provided in the piping on each side of the pressure reducing valves. The gauges shall have 4-1/2" diameter clear faces. The gauge on the inlet side shall have a range of 0-200 PSI and the gauge on the outlet side shall have a range of 0-100 PSI.

The primary pressure reducing valve shall be a Cla-Val Model 690G-01ABC or approved equal. The secondary pressure reducing valve shall be a Cla-Val Model 90G-01ABCS or approved equal. The valves shall both have all stainless steel trim.

The supplier of the pressure reducing stations shall provide 2 bound copies of O&M Manuals to the District, and shall provide on full day at the job site for start-up and training.

In the event a pressure reducing station is proposed, other than as manufactured by Engineered Fluid, Inc., plans of the station showing all structural and piping details shall be submitted along with the water main extensions. Also included shall be details of the PRV's to be furnished. These plans must bear the seal and signature of the Missouri Registered Professional Engineer. Approval of both the plans for the water main extension and the PRV Station must be granted by the District Engineer before the project will be

approved. If requested, structural calculations shall be provided in addition to the drawings of the PRV station. Deviations to the station as specified will only be allowed at the sole discretion of the District Engineer. Care must be exercised that the station is designed to allow easy access to the main PRV and piping and that the top hatch is located such that the main PRV can be easily removed. The contractor shall provide the services of one full day by a representative of the PRV valve manufacturer for start up and training.

17. PUMPING STATIONS, STORAGE TANKS, WELLS, ETC.

Any of the items named above or otherwise required in any project shall be designed, with plans and specifications, signed and sealed by a Registered Professional Engineer in the State of Missouri and approved by the District and MDNR on a case-by-case basis.

SECTION II - WATER DISTRIBUTION SYSTEM INSTALLATION

1. GENERAL

The work covered by this Section of the specifications, shall consist of furnishing all previously specified materials with all necessary equipment, machinery, tools, and labor, and performing all work required to install and/or construct the water system extensions or changes with all directives or modifications and these specifications, all to be; complete, in place, accepted, and ready for use. Failure to comply with these specifications will result in the rejection of the work by the District.

2. SITE AND WORK PREPARATION

Prior to starting the various water main route installations, connections, and/or changes as required, the Contractor shall notify the District a minimum of twenty-four (24) hours prior to the start of construction. After so doing, the Contractor shall clear the route of all trees, shrubs, and other objects or materials that may directly interfere with the construction. It is assumed that all other utility companies or organizations have been notified for location of their respective facilities prior to starting any work. All trees, shrubs, bushes, etc., which will not interfere with the construction shall be protected from damage. Work preparations shall include having all necessary material items, equipment, and an adequate labor force at the site in working condition, and completely instructed and prepared to perform the work to completion as required.

3. DRAINAGE

The Contractor shall control the grading in the vicinity of the pipe trenches so that the surface of the ground will be properly sloped to prevent water from running into the excavated areas. Any water or other liquid wastes that accumulate in the excavated areas shall be promptly removed.

4. STAKING

The staking for water mains shall be provided by the Developer's Engineer or Land Surveyor. Stakes shall be placed along the centerline of the proposed water main or on a fixed offset as requested by the contractor. Stakes shall be set at a maximum spacing of 100 lineal feet and at all valves, fittings, fire hydrants and other appurtenances. The stakes

shall have noted on them the “cut” required to the outside bottom of the water main such that it will have the proper cover relative to the finished grade. Stakes shall also be placed for all water mains to indicate the road rights of way or the limits of easements.

The Contractor shall have the responsibility to avoid conflicts with existing facilities, such as storm sewers and others, and proposed facilities to the extent that conflicts are known to him by the plans and staking in the field.

In the event future fill is required that will result in the water mains having less than 3’-6” of cover at initial installation, the contractor shall place compacted fill over such water mains to provide at least 3’-6” of cover for the initial installation.

For valves, fire hydrants and temporary blowoff assemblies, the stakes shall have the “cut” required noted on them such that all valves, fire hydrants and temporary blowoff assemblies can be set to the proper height to accommodate the final grading.

5. SEPARATION OF WATER MAINS, SANITARY SEWERS AND STORM SEWERS

Water mains shall be laid at least 10 feet horizontally from any existing or proposed sanitary or storm sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten-foot separation, deviations may be made on a case-by-case basis, if supported by data from the design engineer and approved by the District. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid on a separate trench or on an undisturbed earth shelf located on one side of the sewer and in either case, at such elevation that the bottom of the water main is at least 18 inches above the top of the sewer. Water mains crossing sewers shall be laid to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, the full length of water pipe shall be located so both joints will be as far from the sewer as possible.

There shall be at least 10 foot horizontal separation between water mains and sanitary sewer force mains. There shall be an 18 inch vertical separation at crossings as required above for gravity sewers. No water line shall be located closer than 10 feet to any part of a sewer manhole.

In addition to the District’s requirements, separation of water mains, sanitary sewers and combined sewers shall be in accordance with Missouri Department of Natural Resources requirements as given in Appendix A of these Specifications.

6 HANDLING OF MATERIALS

All pipe, fittings, valves and other accessories, shall be unloaded, stored, re-handled, and installed by methods in such a manner as to insure their final location in a sound and undamaged condition, conforming in all respects to specified requirements. Under no circumstances shall pipe, fittings, valves, or other accessories, be dropped to the ground, or otherwise subjected to possible damage from impact or shock. Such materials shall be loaded by lifting with machine or hoist, or by skidding. Pipe handled on skidways shall not be skidded or rolled against other pipe.

Under all circumstances, all materials for use shall be handled in a workman-like

manner, using the necessary manpower and equipment to perform the task in accordance with the manufacturer's recommendations.

All materials shall be handled in such manner that neither the coatings or the linings are damaged. Hooks for insertion into the ends of the pipes, fittings, valves, and other accessories, shall have broad, well-padded contact surfaces, and shall be of such design and size that uniform support will be provided. Under most circumstances, damage to outside coatings is repairable, and the necessary repairs shall be properly made prior to installation. Damage to interior linings is not considered repairable, and therefore, the damaged item shall be replaced at the Contractor's expense.

Proper equipment, tools, facilities, and methods satisfactory to the District, shall be provided and used by the Contractor for the safe handling of all materials. Fittings, valves, and other accessories shall be carefully lowered into the trench or excavation, piece by piece, by means of derrick, to protect coatings and linings. Under no circumstances shall any materials be dropped or dumped into the trench.

7. TRENCH EXCAVATION AND BACKFILLING

Trenches for water mains shall have a minimum width of the pipe O.D. plus 12 inches, and a maximum width of the pipe O.D. plus 24 inches. The finished cover over water mains shall be a minimum of 3'-6" and a maximum of 6'-0". Where additional depth is necessary to clear other utilities or obstructions, the District may grant permission to allow such additional depth.

For PVC pipe, the trench depth shall be excavated 6" deeper than the proposed bottom of the pipe to allow for a 6" granular bedding of compacted ¾" minus rock (See detail A of these specifications). The PVC pipe shall also have the compacted granular material placed to a level 6" above the top of the pipe with care taken to fill all void spaces beneath the pipe.

For ductile iron pipe, if the trench bottom is stable and suitable earth, the pipe may be placed on the earth trench bottom. If the trench bottom contains large stones or solid rock, the trench shall be excavated 6" deeper than the proposed pipe bottom and 6" of compacted bedding material shall be placed before the pipe is laid. The ductile iron pipe shall then have compacted backfill of clean earth or granular bedding material placed to a level 6" above the top of the pipe.

For PVC or ductile iron pipe, if the trench bottom contains frozen material, excessive moisture, debris or other deleterious material, the trench shall be excavated 6" or more deeper than the proposed pipe bottom and backfill to the desired grade with compacted ¾" minus bedding material. For all pipe, bell holes in the trench bottom shall be provided to allow full contact of the pipe with the trench bottom.

Backfill for all pipes under roadways or parking lots shall consist of 1" clean crushed limestone carefully placed to avoid future settlement from 6" above the top of the pipe to the finished grade. In other areas, the backfill may be excavated earth, free of large stones, frozen material, vegetation or debris. Backfilling of all pipe shall be well compacted by means of jetting or other approved methods to eliminate settling. Any completed areas that show settlement shall be promptly re-backfilled with compacted clean earth or compacted 1" clean rock as required for the initial backfill. Refer to Detail A of these specifications.

8. PIPE INSTALLATION

Laying of the pipe shall commence immediately after the excavation is started, and the Contractor shall use every possible means to keep the completed pipe installation closely behind the trenching. The Water District may stop the trenching if it appears that the trench is open too far in advance of the pipe laying operation. The Contractor may lay pipe in the best manner adapted to securing speed and good results. The Contractor shall have the necessary equipment and tools available for making the joints for the specific materials being used.

All pipe spigot ends shall be visibly marked to fully "make-up" the joint. With exception of field cut pipe, all "make-up" marks shall be placed on the pipe at the factory. Field cut pipe shall be marked for full joint depth prior to insertion.

Cutting of pipe for closure pieces with installation of valves or fittings, or for any other reason, shall be done in a neat and workman-like manner without damage to the pipe or linings. The cutting operation shall leave a smooth cut end at right angles to the longitudinal axis of the pipe. The exterior surface of the cut end shall be beveled, and the interior surface shall be reamed or filed free of all rough edges and protrusions. All pipe cutting shall be done by saw or mechanical pipe cutters of an approved type.

Upon completion of the cutting and trimming operation, the pipe end or ends shall be marked for "make-up" depth. Prior to insertion, the pipe shall be thoroughly cleaned of all foreign materials, including filing and cutting debris.

Pipe lines are intended to be laid straight. Deflections at fittings and at ductile iron joints will be allowed when necessary but shall not exceed 2-1/2 degrees or 10" per 20' pipe length at any one joint. Bending of PVC will be allowed only when absolutely necessary and shall be done by hand tools to avoid damage to the pipe. Bending of PVC pipe shall not exceed the following limitations:

Pipe Size	Degree of Bending	Deflection Per 20' Length	Minimum Radius (Ft.)
4"	3.5 degrees	15"	164'
6"	2.5 degrees	11"	230'
8"	2.0 degrees	8.5"	287'
12"	1.0 degrees	5"	573'

9. THRUST BLOCKING AND FITTING SUPPORTS

All horizontal mechanical joint fittings 12" and smaller such as tees, bends and plugs (except for fire hydrants) shall be thrust blocked with poured concrete as shown in Detail C of these specifications. Concrete shall be as specified in Section I of these specifications and forms shall be provided to avoid concrete encasement of any part of mechanical joints. All form material shall be removed from the trench prior to backfilling. The pre-cast concrete block supports for fittings shall be required for all fittings installed. For restraint of unbalanced thrust for fittings larger than 12", conventional thrust blocking may be used with a design based on a pressure of 200 PSI and a passive soil resistance of

2,000 PSF. For ductile iron pipe larger than 12", restraints for fittings may be designed using restrained joints in the pipe and fittings. However if such restraints are provided, calculations signed and sealed by a Missouri Registered Professional Engineer shall be provided. All restraint systems are subject to the approval of the District.

In general the grade or slopes where new water mains are to be installed shall not exceed 10%. Where grades are in excess of 10% but not greater than 25%, each joint of pipe shall be restrained by means of restrainers installed at the pipe joints. Where lengths of pipe to be restrained exceed 100' in length, the restrainer shall be omitted at each 100' interval. The restrainers shall be as specified below or approved equal.

For Class 200 Pressure Rated (SDR21) PVC: Uniflange 1350-S or Ebba Iron 6500

For Ductile Iron Pipe: Uniflange 1350-c or Ebba Iron 1500

10. QUALITY OF MATERIALS

All materials used for each water main project shall be new. Damaged or unsound pipe, fittings and accessories of whatever nature shall be rejected and removed from the work. All joints shall be made as previously specified. Each piece of pipe and all fittings, valves, etc., shall be checked and cleared of debris prior to being put in place. All gaskets shall be checked and cleaned of oil, grease, dirt, etc., before being inserted. All bolted joints shall be rechecked for operation and bolt tightness prior to installation. All open ends of pipe, fittings, etc., shall be carefully plugged or sealed at the end of each days work to prevent entrance of animals, water, and other foreign matter. All excavation shall be made to neat line and grade.

All personnel involved in any way with the work must be made aware of the fact that the work shall result in a first-class, professional job.

11. POLYETHYLENE ENCASEMENT INSTALLATION

The Contractor shall furnish all materials and install the polyethylene encasement as specified in the previous Section of these specifications and in accordance with AWWA C-600. The polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and bedding material but is not intended to be a completely airtight and watertight enclosure. Overlaps shall be secured by the use of adhesive tape, plastic string, or any other material capable of holding the polyethylene encasement in place until backfilling operations are completed.

This Article includes three different methods of installation of polyethylene encasement on pipe. Methods A and B are for use with polyethylene tubes and Method C is for use with polyethylene sheets.

Method A - One length of polyethylene tube for each length of pipe:

The Contractor shall cut the polyethylene tube to a length of approximately two (2) feet longer than that of the pipe section. The tube shall then be placed around the pipe, centered to provide one (1) foot of overlap one each adjacent pipe section, and bunched accordion-fashion lengthwise until it clears the pipe ends.

The pipe shall be lowered into the trench and the joint made up with the preceding

section of pipe. A shallow bell hole shall be made at joints to facilitate installation of the polyethylene tube. After assembling the pipe joint, the bunched polyethylene shall be pulled from the preceding length of pipe, slipped over the end of the new length of pipe, and secured in place. The end of the polyethylene from the new pipe section shall be placed over the end of the first wrap until it overlaps the joint at the preceding length of pipe. The overlap shall next be secured in place by taking up slack width to make a snug, but not tight, fit along the barrel of the pipe and securing the fold at quarter points.

All rips, punctures, or other damage to the polyethylene shall be repaired with adhesive tape or with a short length of polyethylene tube cut open, wrapped around the pipe, and secured in place. Proceed with installation of the next section of pipe in the same manner.

Method B - Separate pieces of polyethylene tube for barrel of pipe and for joints:

The Contractor shall cut the polyethylene tube to a length of approximately one (1) foot longer than that of the pipe, centered to provide six (6) inches of bare pipe at each end. Make polyethylene snug, but not tight; secure ends as described for Method A.

Prior to making up a joint, a three (3) foot length of polyethylene tube shall be placed over the end of the preceding pipe section, bunched accordion-fashion lengthwise. After completion of the joint, the three (3) foot length of polyethylene shall be pulled over the joint, overlapping the polyethylene previously installed on each adjacent section of pipe by at least one (1) foot; made snug and secure at each end as described for Method A.

All rips, punctures, or other damage to the polyethylene shall be repaired as described in Method A. Proceed with installation of the next section of pipe in the same manner.

Method C - Flat polyethylene sheet encasement:

Contractor shall cut polyethylene sheet to a length of approximately two (2) foot longer than that of the pipe section. The cut length shall be centered to provide a one (1) foot overlap on each adjacent pipe section, bunching it until it clears the pipe ends.

The polyethylene shall be wrapped around the pipe so that it circumferentially overlaps the top quadrant of the pipe. The cut edge of the polyethylene shall be secured at intervals of approximately three (3) foot.

The wrapped pipe shall be placed into the trench and the pipe joint made up with the preceding section of pipe. A shallow bell hole shall be made at the joints to facilitate installation of the polyethylene. After completion of the joint, the overlap shall be as described for Method A.

All rips, punctures, or other damage to the polyethylene shall be repaired as described for Method A. Proceed with installation of the next section of pipe in the same manner.

POLYETHYLENE ENCASEMENT INSTALLATION (Cont.)

Bends, reducers, offsets, and other pipe-shaped appurtenances shall be covered with polyethylene in the same manner as the pipe. When valves, tees, crosses, and other odd-shaped pieces cannot be wrapped practically in a tube, they shall be wrapped with a flat sheet or split length of polyethylene tube by passing the sheet under the appurtenance

and bring it up around the body. Seams shall be made by bringing the edges together, folding over twice, and taping down. Width and overlaps at joints shall be handled as described for Method A. Polyethylene shall be taped securely in place at valve stem and other penetrations.

Where encountered, the Contractor shall provide openings for branches, service taps, blow-offs, air valves, and similar appurtenances by making an X-shaped cut in the polyethylene and temporarily folding back the film. After the appurtenance is installed, the slack shall be securely taped at the appurtenance and the cut repaired, as well as any other damaged areas in the polyethylene, with tape.

Where polyethylene-wrapped pipe joins an adjacent pipe that is not wrapped, the Contractor shall extend the polyethylene wrap to cover the adjacent pipe for a distance of at least two (2) feet. The end shall be secured with circumferential turns of tape.

The Contractor shall use the same backfill material as that specified for pipe without polyethylene wrapping, exercising care to prevent damage to the polyethylene wrapping when placing backfill. Backfill material shall be free from cinders, refuse, boulders, rocks, stones, or other materials that could damage the polyethylene.

12. WATER MAIN TRACER TAPE INSTALLATION

The Contractor shall furnish all materials and install the water main tracer tape as specified in the previous Section of these specifications. The three (3) inch wide detectable tape shall be installed directly above the water main locations as the trench backfill progresses, to permit an earth or granular cover of 12 to 18 inches over the tape. The tape material shall be installed in accordance with the manufacturer's recommendations. The tape is to be placed in a manner such that trench backfill settlement will not place an excessive tensile stress on the material.

13. WATER MAIN LOCATER WIRE INSTALLATION

The Contractor shall furnish all materials and install the water main locator wire as specified under the previous Section of these specifications. The No. 12 insulated wire shall be placed along the top of the water main and taped in place with duct tape or electrical tape at a maximum of 6' intervals. All locator wire shall be tested for continuity as called for in Section II-27 of these Specifications.

13. WATER MAIN LOCATER WIRE INSTALLATION (Cont.)

For ductile iron pipe the locator wire shall be placed outside the polyethylene encasement. Caution must be exercised in the initial backfilling not to move or damage the locator wire. The wire shall be brought up the outside of each valve box from each direction and then both wires are to be threaded into the valve box through the ½" diameter hole near the top in the initial installation.

The two wires shall be spliced inside the valve box with a standard plastic or rubberized wire connector. After testing for continuity, the splices inside the box shall be made with a 3 M splice kits. Where splices become necessary outside of valve boxes, the splices shall be made initially with a 3 M splice kit.

Where water mains are dead end with a cap installed for a future extension, a 6' long steel "T post" extending 3' into the ground, with 3' exposed shall be provided as shown on Detail G of these specifications. In these cases the locator wire shall be brought

up out of the ground and securely wrapped around the “T post” and secured with electrical tape.

14. VALVE INSTALLATION

Prior to installation, all valves shall be checked for bolt tightness and operation. All foreign matter, dirt, and debris, shall be removed from inside the valve body. The valve gate and guide shall be cleaned free of grease and dirt. After thoroughly cleaning and checking the valve for operation, the valve gate shall be opened, and the valve shall be installed in place. All valves shall have pre-cast concrete block supports, the same as for fittings as shown on Detail C of these Specifications.

Valve boxes shall be set plumb and earth or ground fill shall be tamped around the box to maintain the plumb position and the lid or cover to correspond with finished grade based on the “height” indicated on the stakes for the valves.

In general, valves shall be provided at intervals of not greater than 500 feet. Additionally, at all tee intersections, a minimum of two (2) valves shall be provided, and at cross intersections, a minimum of three (3) valves shall be provided.

15. FIRE HYDRANT INSTALLATION

Fire hydrants shall be installed where shown on the plans and as shown on Detail B of these Specifications. Care shall be taken to set the hydrant plumb and the 4-1/2” pumper nozzle shall face the street. Care shall also be exercised to set the fire hydrants to meet the final finished grade as indicated by the “height” given on the stake for the hydrant. After installation and backfill, the exposed barrel and top shall be given a finish coat of “Chrome yellow” paint. The operating nuts on the top of fire hydrant shall not be painted.

FIRE HYDRANT INSTALLATION (Cont.)

In general, fire hydrants will not require thrust blocks when they are restrained by “Anchor Loks” or “Megalug” follower glands as shown on Detail B of these specifications. However, if they are installed at a dead end, a thrust block, same as for a 6” x 6” tee shall be provided to restrain the fire hydrant and care shall be taken not to encase the drain hole in the fire hydrant.

16. TEMPORARY BLOWOFF INSTALLATION

In general, blowoffs will not be allowed at dead ends of the system, but fire hydrants will be required at the ends of dead end mains. Where it is expected that a main will be extended in the near future, a temporary manual blowoff device, as shown on Detail G of these Specifications shall be provided.

17. WORK ADJACENT TO AND/OR CROSSING HIGHWAYS

All work to be performed within the right-of-way limits of Highways shall be performed in strict accordance with the Highway Department requirements. The Contractor shall obtain the necessary permits for all work prior to starting any construction. All permits must be displayed as required.

The Contractor shall comply with all requirements such as; signals, flagman, and watchmen; performance of work in such a manner so as not to interfere with traffic, highway entrances, highway maintenance, highway drainage, etc., and methods of placing

materials, backfill compaction, and all such other requirements, which may differ from or may be in addition to those specified for work other than that within the highway right-of-way limits.

Highway crossing shall be constructed in accordance with all permit requirements. The Contractor will be held responsible for any and all expense incurred by the Highway Department in protecting the highway while construction is in progress, or as a result of said construction.

The Contractor will also be held responsible for all damages to the highway due to operations during construction including replacement of damaged pavement.

The crossings shall be machine bored with simultaneous installation of the encasement. Boring without the concurrent installation of the encasement tube will not be permitted. All joints of the encasement tube shall be welded as specified and the encasement tube shall extend to the required dimensions.

WORK ADJACENT TO AND/OR CROSSING HIGHWAYS (Cont.)

Following completion of the machine bored crossing, all bore pit or other required excavation shall be suitably backfilled to grade. All debris, of whatever nature, shall be picked up and removed from the site. After clean-up, the disturbed area shall be smoothed to grade, seeded, and covered with straw. The entire work area shall be left in an orderly and acceptable condition.

18. INSTALLATION OF TAPPING SLEEVES AND VALVES

The tapping sleeves shall be carefully installed on existing pipes with tightening of bolts done carefully to avoid stresses on the existing water mains. If "Power Seal" tapping sleeves are used, particular care shall be used to follow the bolt tightening sequence as recommended by the manufacturer. The tapping valve shall then be attached to the tapping sleeve with support blocks provided as called for in Section II-14 of these Specifications. The pit for the tapping machine shall be adequate in size.

Prior to the tap being made, with the tapping valve closed, the assembly shall be air tested to a pressure of 150 PSI, using the port provided on the tapping sleeve. After the tap is completed, the "coupon" removed shall be given to the District's representative for examination. When the tap is complete, concrete thrust blocking with the same dimensions as for a tee of the same size shall be poured behind the tapping sleeve. If the pit is to be temporarily backfilled, before pipe laying continues, a mechanical joint plug shall be installed in the outlet of the tapping valve to prevent dirt or debris from entering the valve. The tapping valve shall have a valve box as specified herein for gate valves.

19. CREEK OR DITCH CROSSINGS

Where water mains cross creeks, all piping shall be ductile iron piping. Proper fittings shall be provided and all piping (except at the joints) shall be encased in concrete, all as shown on Detail F of these Specifications. The determination of what constitutes a creek and the requirements for concrete encasement shall be made by the District Engineer. Specifically, surface water crossings shall be in accordance with Missouri Department of Natural Resources requirements as given in Appendix B of these Specifications. Any required U.S Army Corps of Engineers permits must be acquired by the Contractor and all requirements of such permits must be met by the contractor.

20. AIR RELEASE DEVICES

Where there are pronounced high spots in water mains 12" and smaller and there are no fire hydrants located at said high spots, a manual air release device as detailed on Detail E of these Specifications shall be installed. For high spots in water mains larger than 12", automatic air release valves shall be provided as specified hereinbefore. All manual and automatic air release devices are to be permanent.

21. INSTALLATION OF MAIN LINE PRESSURE REDUCING STATIONS

The station shall be installed at locations shown on the plans and shall be as specified in Section I of these Specifications. Prior to installation the concrete support pad, 12" thick reinforced with #4 bars at 12" each way, each face shall be poured. The concrete shall be as specified in Section I for thrust blocking. The pad shall have hooked all thread 3/4" steel rods carefully spaced for anchoring the station in place. The pad shall be poured level and all details shall be submitted to, and approved by the District Engineer before the pad is poured. Pressure settings for the two pressure reducing valves in the station will be provided by the District Engineer.

22. DISINFECTION

Disinfection shall be accomplished by placing sufficient hypochlorite granules (HTH) in each section of pipe to achieve a chlorine residual in the pipeline, upon initial filling, of 50 mg/L (PPM). HTH tablets will not be allowed. Following completion of the pipeline, it shall be slowly filled with water and a sample will be taken immediately and the chlorine residual must be 50 mg/L or greater. The solution shall be allowed to stand for 24 hours and a sample shall be taken. The chlorine residual after 24 hours shall be 10 mg/L or greater. If the piping shows insufficient chlorine residuals in either test, the piping shall be re-chlorinated by the injection of a hypochlorite solution until satisfactory results are achieved. All disinfection shall be done by the contractor. Only the testing to determine the chlorine residual will be done by the District.

23. PRESSURE TESTING

Immediately following disinfection, the piping shall be pumped to a pressure (at the lowest point in the project) of 150 PSI or higher where the working pressure is higher than 150 PSI as determined by the District. In such cases, the test pressure shall be as specified by the District and two pressure tests shall be conducted. The first test shall be with the fire hydrant auxiliary valves open and be to 150 PSI. The second test shall be with the fire hydrant auxiliary valves closed and be to the higher pressure as directed by the District. All pumping equipment and pressure gauges shall be provided by the contractor. After achieving the test pressure, the piping shall be left closed for a period of two (2) hours. At the end of this time the pressure drop shall not exceed 2 PSI. In addition, if the pressure appears, in the judgment of the District's representative, to be continuing to drop, the test shall be continued for another two (2) hours and if any further drops occur, the test shall be considered a failure. If the pressure test fails, the contractor will be required to find and correct the source of the leakage. If this requires draining of the pipeline, when the leakage is corrected, the piping must be re-disinfected and the pressure tested again until satisfactory results are achieved. Any MDNR required dechlorination will be performed by the contractor.

24. FLUSHING

After satisfactory disinfection is achieved, all piping shall be thoroughly flushed until all water discharged is visibly clear. A final chlorine residual test will then be taken and the chlorine residual must be between 0.5 - 2.5 mg/L. If the residual is too high, additional flushing shall be done until the desired residual is obtained. If the residual is too low, the entire disinfection and flushing procedure shall be repeated until the desired results are achieved. Any MDNR required de-chlorination will be performed by the contractor.

25. BACTERIOLOGICAL TESTING (Revised 5-27-08)

After satisfactory disinfection and pressure testing, samples shall be taken by the contractor, or owner, in the presence of a District representative and submitted to a laboratory approved by the Missouri Department of Natural Resources and the District for bacteriological analysis. Following a minimum 24-hour period but not less than 7-days a second set of samples shall be taken in like manner and submitted for analysis. One sample shall be taken at the first outlet (tap, hydrant etc.) from the storage facility. A minimum on one (1) additional sample shall be taken at the extreme end of the system from the storage facility, but the district representative may request additional samples as he/she determines necessary to provide a representation of the distribution system. Copies of the analysis shall be supplied to the District. Analytical method used to determine water quality (safe or unsafe) will be "presence/absence". Other methods will not be considered acceptable by the District. If samples are found to be *unsafe*, further flushing and/or disinfection shall be conducted until two (2) sets of samples are taken by the contractor, or owner, and all samples are found to be "safe". Upon completion of satisfactory bacteriological testing and all required submittals to the Missouri Department of Natural Resources are completed and submitted and with the approval by the District, the system may be placed into service.

26. SITE CLEAN UP AND GRADING

After work is completed, the site of all water main installation work shall be cleared of all construction material and other debris. Grading shall be as agreed upon between the contractor and the developer, but shall consist of a minimum of rough grading to provide proper drainage and all installation sites shall be left in a neat clean and acceptable condition. All walkways, driveways, roads, streets, etc. shall be replaced to their original condition. All water mains shall be left with the proper amount of cover as hereinbefore stated. For all water work in easements or other property other than the property of the Developer, the site shall be restored to a condition equal to, or better than, its condition before the work was started. In any lawn areas, the final restoration shall include sodding.

27. FINAL INSPECTION AND LOCATER WIRE TESTING

After all work is completed and all disinfection, flushing and bacteriological testing are complete, the contractor shall conduct a locator wire test between all sections of the wire in the presence of a District representative. If the test is satisfactory, all splices in valve boxes shall be made permanent by means of 3-M splice kits. If the tests fail in a section, the contractor must find and repair any failure in the locator wires. A final inspection shall be made by a District representative and all valves and fire hydrants shall be plumb and be to proper grade and all clean up work must be satisfactorily completed. The work shall be accepted only after completion of the final inspection.

Any defects found in the final inspection shall be promptly corrected by the contractor.

28. AS BUILT DRAWINGS

During the course of the work, the Contractor must have in his possession at all time a copy of the Plans, approved by the District. As work progresses, the Contractor shall note all lengths of pipe installed, all valves, fire hydrants and other appurtenances installed and record all dimensions required to locate these items. At the completion of the project, and prior to acceptance by the District, the Contractor shall furnish the copy of the plans where all “as built” dimensions and notes are endorsed. The plans must be relatively clean and totally legible with regard to all notes made thereon.

29. GUARANTEE

The contractor shall guarantee all material and workmanship for a period of a minimum of three (3) years following final acceptance of the work by the District.

APPENDIX A

All Construction shall conform to the following taken from the “Design Guide for Community Water Systems” (effective August 29, 2003) as published by the Missouri Department of Natural Resources and as partially reproduced below. As MDNR’s requirements change in the future, the latest edition of their rules will apply.

8.6. Separation of Water Mains, Sanitary Sewers and Combined Sewers

8.6.1. General.

The following factors should be considered in providing adequate separation:

- a. Materials and type of joints for water and sewer pipes;
- b. Soil conditions;
- c. Service and branch connections into the water main and sewer line;
- d. Compensating variations in the horizontal and vertical separations;
- e. Space for repair and alterations of water and sewer pipes; and
- f. Off-setting of water mains around manholes.

8.6.2. Parallel installation.

Water mains shall be laid at least ten feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten-foot separation, the department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer and on either case, at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. In areas where the recommended separations cannot be obtained, either the waterline or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing.

8.6.3. Crossings.

Water mains crossing sewers shall be laid to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, the full length of water pipe shall be located so both joints will be as far from the sewer as possible but in no case less than ten feet. Special structural support for the water and sewer pipes may be required. In areas where the recommended separations cannot be obtained either the waterline or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing that extends no less than ten feet on both sides of the crossing.

8.6.4. Exception.

Any variance from the specified separation distances in paragraphs 8.6.2. and 8.6.3. must be submitted to the department for approval.

APPENDIX A (CONT)

8.6.5. Force mains.

There shall be at least a ten-foot horizontal separation between water mains and sanitary sewer force mains and they shall be in separate trenches. In areas where these separations cannot be obtained, either the waterline or the sewer line shall be cased in a continuous casing.

8.6.6. Sewer manholes.

No waterline shall be located closer than ten feet to any part of a sanitary or combined sewer manhole.

8.6.7. Disposal facilities.

No waterline shall be located closer than 25 feet to any on-site wastewater disposal facility, agricultural waste disposal facility, or landfill.

APPENDIX B

All Construction shall conform to the following taken from the “Design Guide for Community Water Systems” (effective August 29, 2003) as published by the Missouri Department of Natural Resources and as partially reproduced below. As MDNR’s requirements change in the future, the latest edition of their rules will apply.

8.7. Surface Water Crossings.

Surface water crossings, whether over or under water, present special problems. The department should be consulted before final plans are prepared. Positive joints shall be required in waterways and wet weather streams.

8.7.1. Above-water crossings.

The pipe shall be adequately supported and anchored, protected from damage and freezing and accessible for repair or replacement.

8.7.2. Underwater crossings.

a. Flowing streams.

A minimum cover of four feet shall be provided over the pipe. When crossing water courses are greater than 15 feet in width, the following shall be provided:

1 The pipe shall be of special construction, having flexible watertight joints. Steel or ductile iron ball-joint river pipe shall be used for open cut crossings. Restrained joint pipe may be used for open cut crossings, provided it is encased in a welded steel casing. Restrained joint or fusion weld pipe shall be used for bored crossings.

2 Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible and should not be subject to flooding; and the valve closest to the supply source shall be in an accessible location.

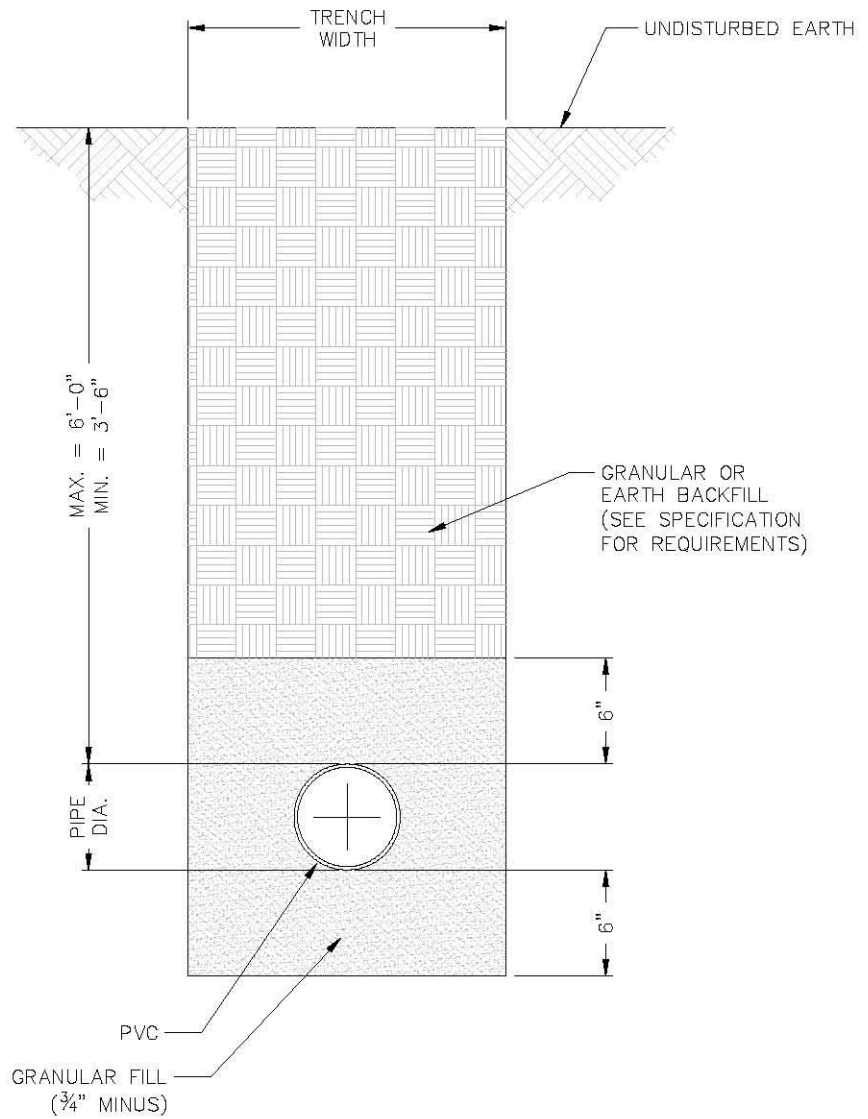
3 Permanent taps shall be provided on each side of the valve within the manhole to allow insertion of a small meter to determine leakage and for sampling purposes.

4 The stream crossing pipe or casing shall extend at least 15 feet beyond the upper edge of the stream channel on each side of the stream.

b. Intermittent flowing streams.

1 Restrained joint pipe shall be used for all stream crossings.

2 The pipe shall extend at least 15 feet beyond the upper edge of the stream channel on each side of the stream.



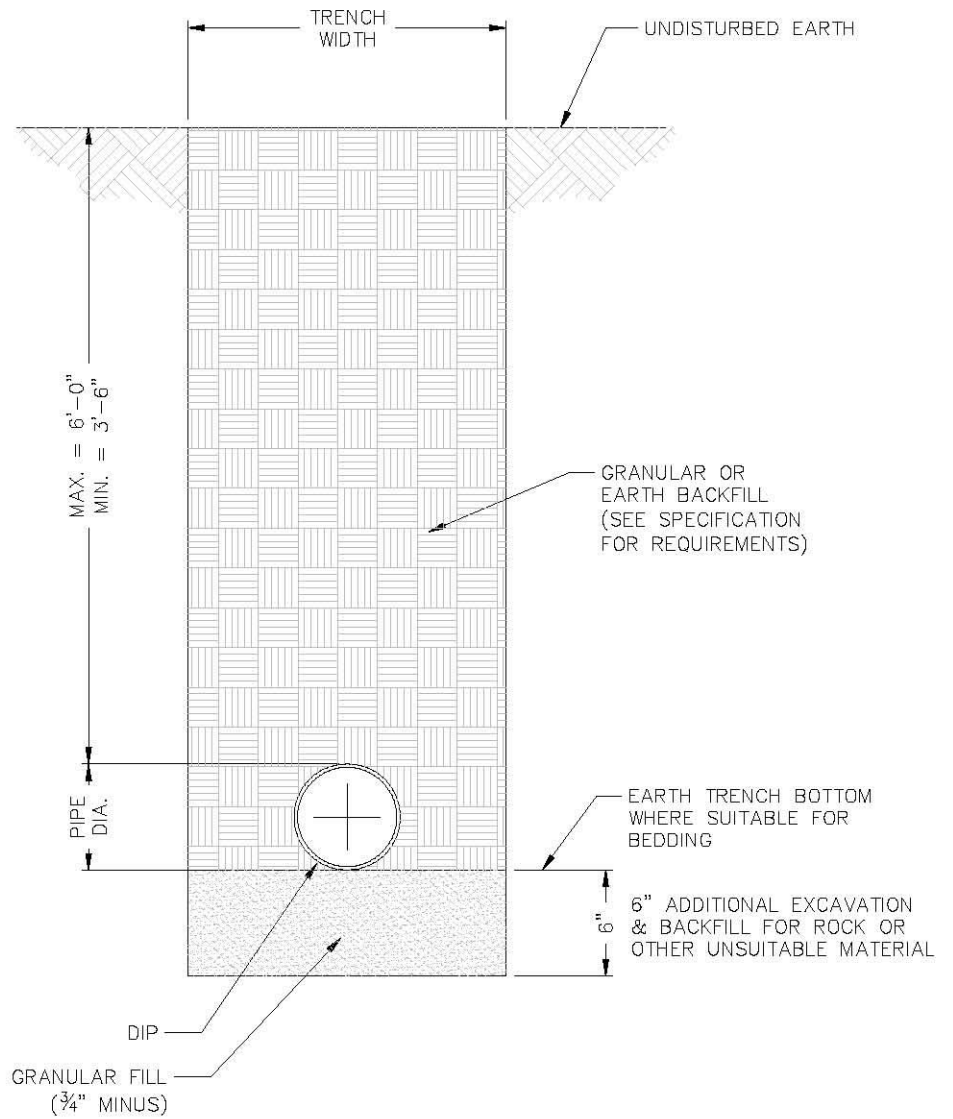
NOTES

SEE SPECIFICATIONS FOR ADDITIONAL
DETAILS FOR BEDDING AND BACKFILL.

TYPICAL TRENCH SECTION
FOR PVC PIPE

NOT TO SCALE

DETAIL "A"

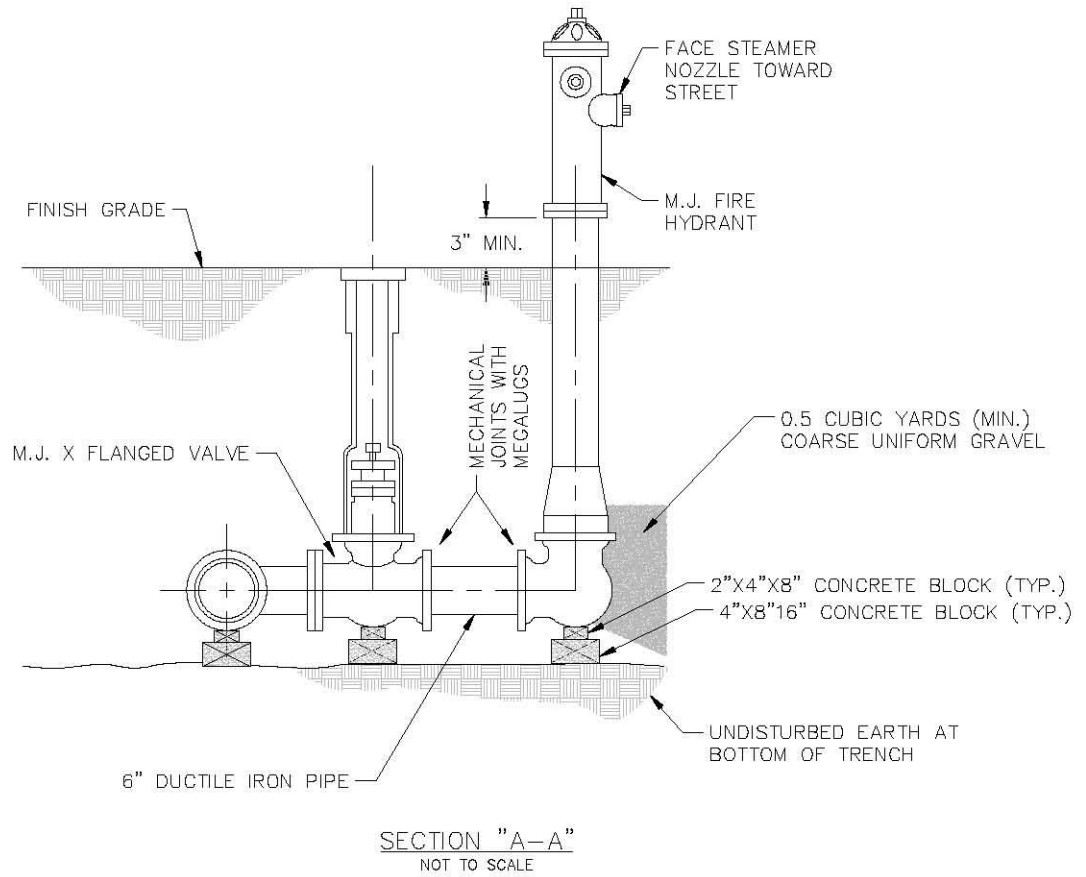
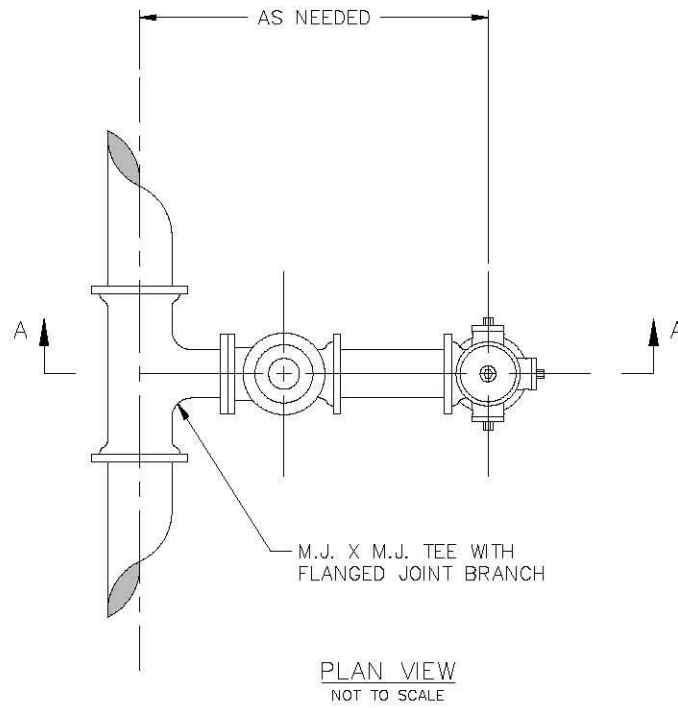


NOTES

SEE SPECIFICATIONS FOR ADDITIONAL
DETAILS FOR BEDDING AND BACKFILL.

**TYPICAL TRENCH SECTION
FOR DUCTILE IRON PIPE**

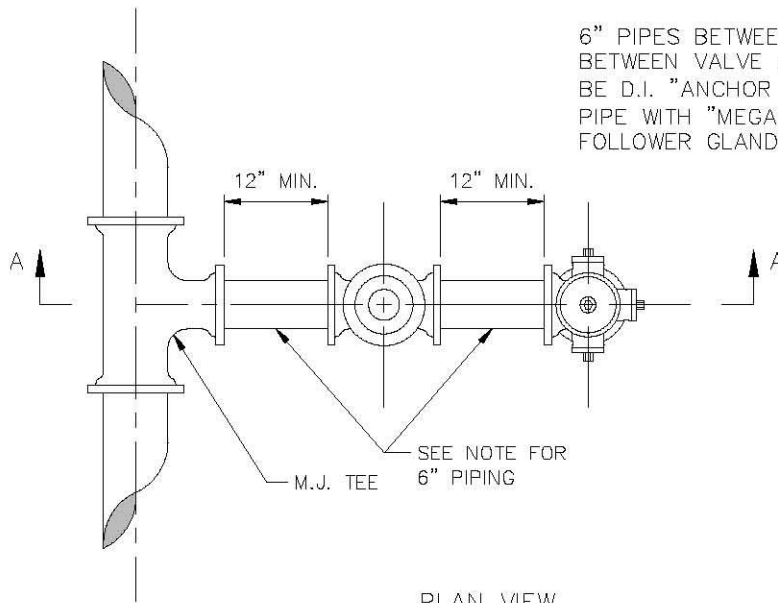
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DETAIL "A"



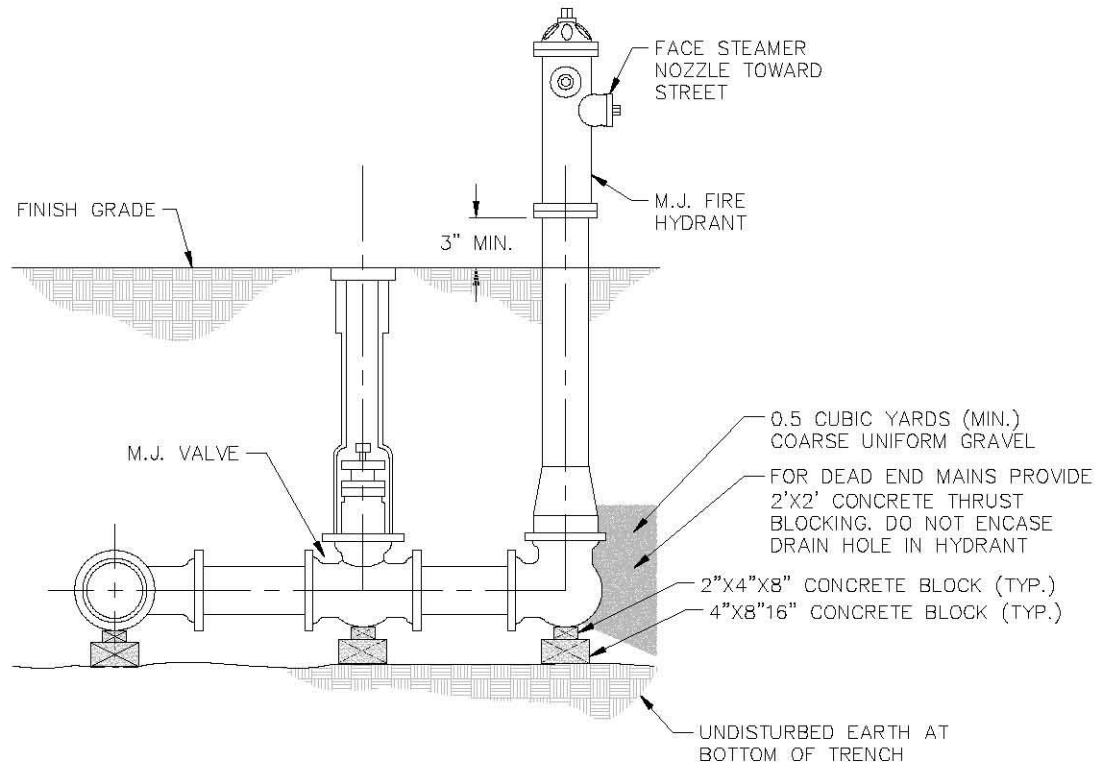
STANDARD
FIRE HYDRANT DETAIL
DETAIL "B"
SHEET 1 OF 3

NOTES

6" PIPES BETWEEN TEE AND VALVE AND BETWEEN VALVE AND FIRE HYDRANT SHALL BE D.I. "ANCHOR LOKS" OR DUCTILE IRON PIPE WITH "MEGALUG" RESTRAINER FOLLOWER GLANDS ON ALL M.J. JOINTS.



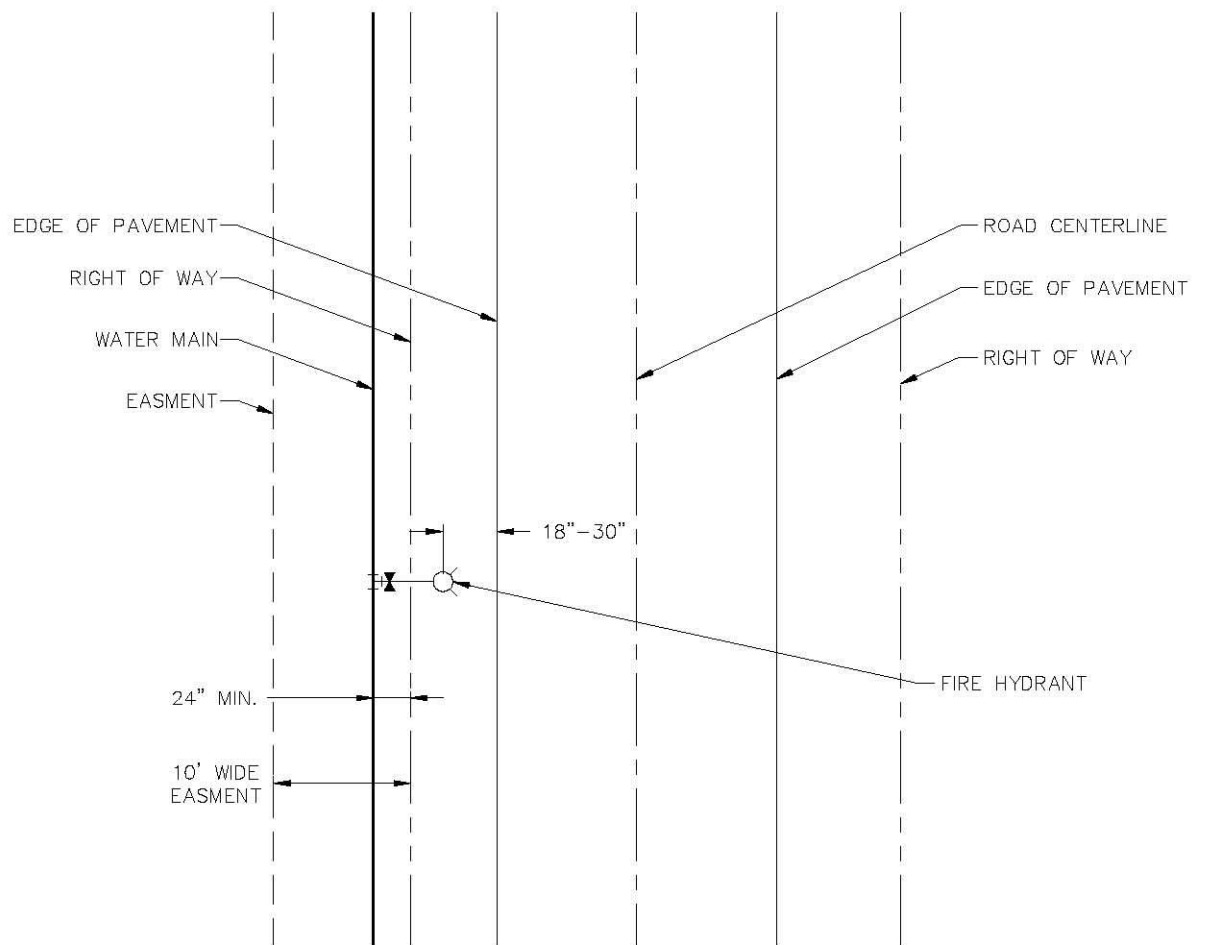
PLAN VIEW
NOT TO SCALE



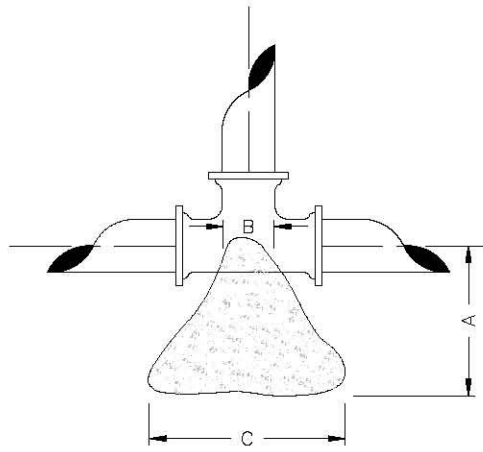
SECTION "A-A"
NOT TO SCALE

OPTIONAL
FIRE HYDRANT DETAIL

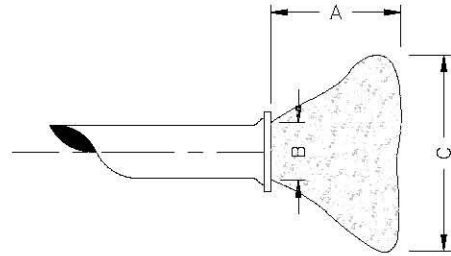
DETAIL "B"



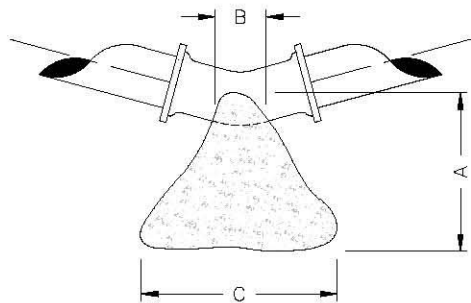
FIRE HYDRANT LOCATION
NOT TO SCALE



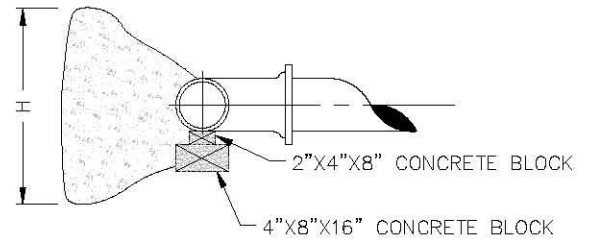
TEES AND TAPPING
SLEEVE
NOT TO SCALE



PLUGS
NOT TO SCALE



BENDS
NOT TO SCALE



TYPICAL SECTION
NOT TO SCALE

THRUST BLOCK DIMENSIONS - INCHES

PIPE DIA.	ALL FTGS.		TEE PLUG TAPPING		90 DEGREE BEND		45 DEGREE BEND		22-1/2 BEND		11-1/4 BEND	
	A	B	C	H	C	H	C	H	C	H	C	H
4	14	4	24	12	26	15	18	12	12	12	12	12
6	16	6	36	18	36	24	30	18	24	12	12	12
8	20	8	36	30	42	36	36	24	24	18	18	12
10	20	10	48	36	66	36	36	36	28	24	18	18
12	24	12	68	36	82	42	52	36	40	24	28	18

NOTE

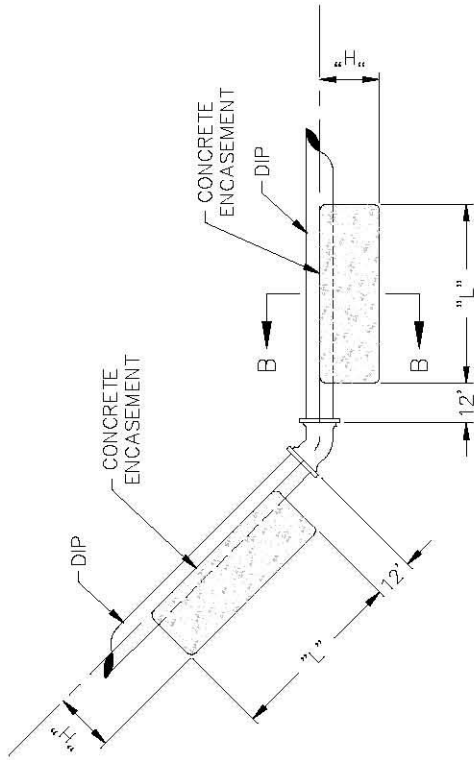
FOR FITTINGS LARGER THAN 12", SPECIAL RESTRAINT DESIGNS ARE REQUIRED.

HORIZONTAL THRUST BLOCKING

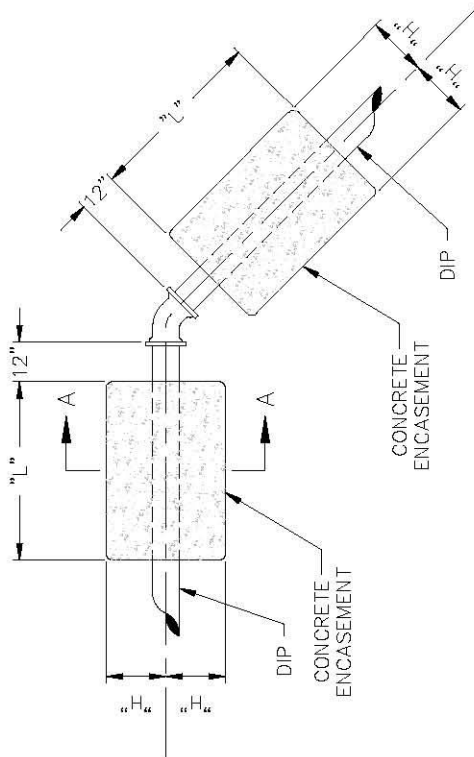
DETAIL "C"

THRUST BLOCK DIMENSIONS - INCHES

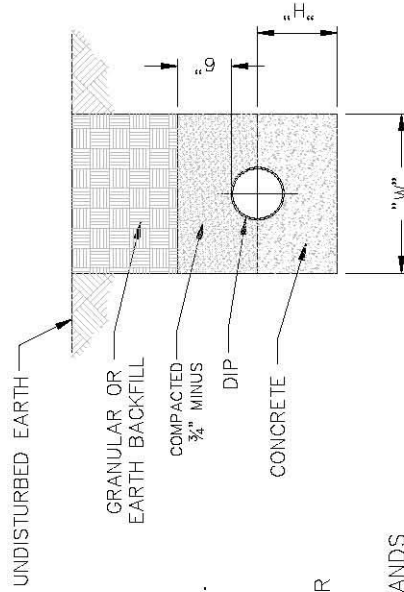
PIPE DIA.	ALL FTGS.		45 DEGREE BEND TEE PLUG TAPPING 90 DEGREE BEND						22-1/2 BEND		11-1/4 BEND	
	AB		CH		CHC		HC		HC		H	
4	14	4	2412		2615		1812		1212		1212	
6	16	6	3618		3624		3018		2412		1212	
8	20	8	3630		4236		3624		2418		1812	
10	20	10	48	36	66	36	36	36	28	24	18	18
12	24	12	68	36	82	42	52	36	40	24	28	18



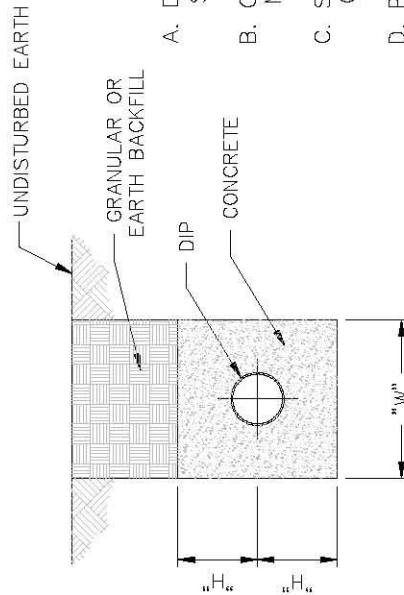
UP BEND
NOT TO SCALE



DOWN BEND
NOT TO SCALE



UP BEND
SECTION B-B
NOT TO SCALE



DOWN BEND
SECTION A-A
NOT TO SCALE

NOTES

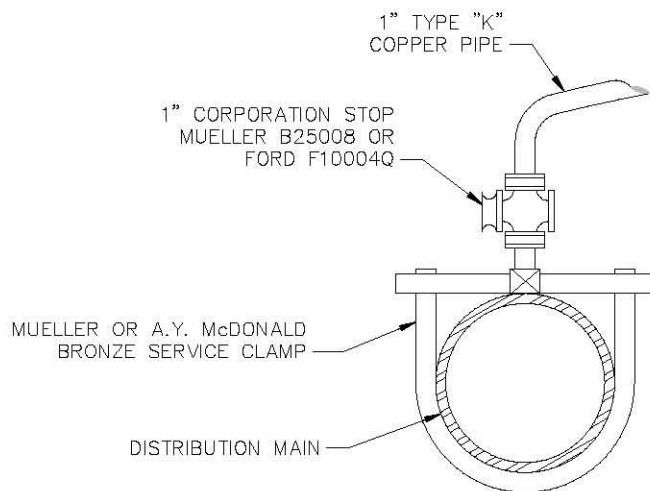
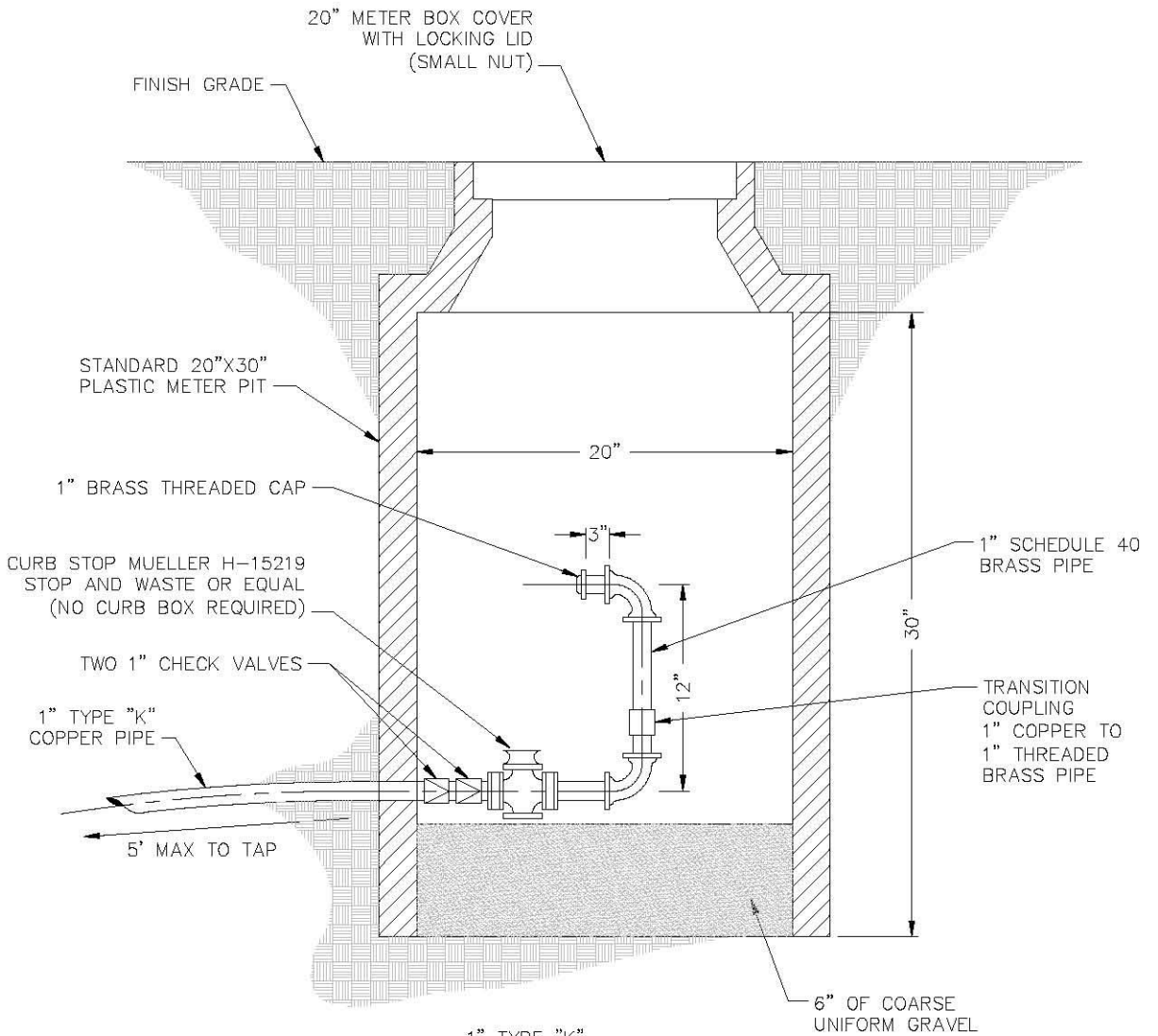
- A. DIP ON EACH SIDE OF FITTING SHALL BE "L" + 24" IN LENGTH.
- B. CONNECT DIP TO PVC PIPE WITH MJ SOLID SLEEVE.
- C. SEE TABLE ON PAGE 2 OF 2 FOR CONCRETE DIMENSIONS.
- D. PROVIDE MEGALUG FOLLOWER GLANDS FOR JOINTS OF ALL VERTICAL BENDS.
- E. FOR FITTINGS LARGER THAN 12", SPECIAL RESTRAINT DESIGNS ARE REQUIRED.

VERTICAL THRUST BLOCKING

DETAIL "D"

PIPE SIZE	DEGREE BEND	DOWN BENDS			UP BENDS		
		W	H	L	W	H	L
4"	11 1/4°	18	12	18	12	12	12
	22 1/2°	18	18	24	12	12	12
	45°	18	18	30	12	12	18
6"	11 1/4°	24	18	18	12	12	12
	22 1/2°	24	18	24	12	12	12
	45°	24	18	48	12	12	18
8"	11 1/4°	24	18	24	12	12	18
	22 1/2°	24	18	42	12	12	24
	45°	24	18	48	18	12	24
10"	11 1/4°	30	24	24	18	18	18
	22 1/2°	30	24	42	18	18	24
	45°	30	24	72	18	18	36
12"	11 1/4°	30	24	30	18	18	18
	22 1/2°	30	24	54	18	18	30
	45°	30	36	72	24	18	36

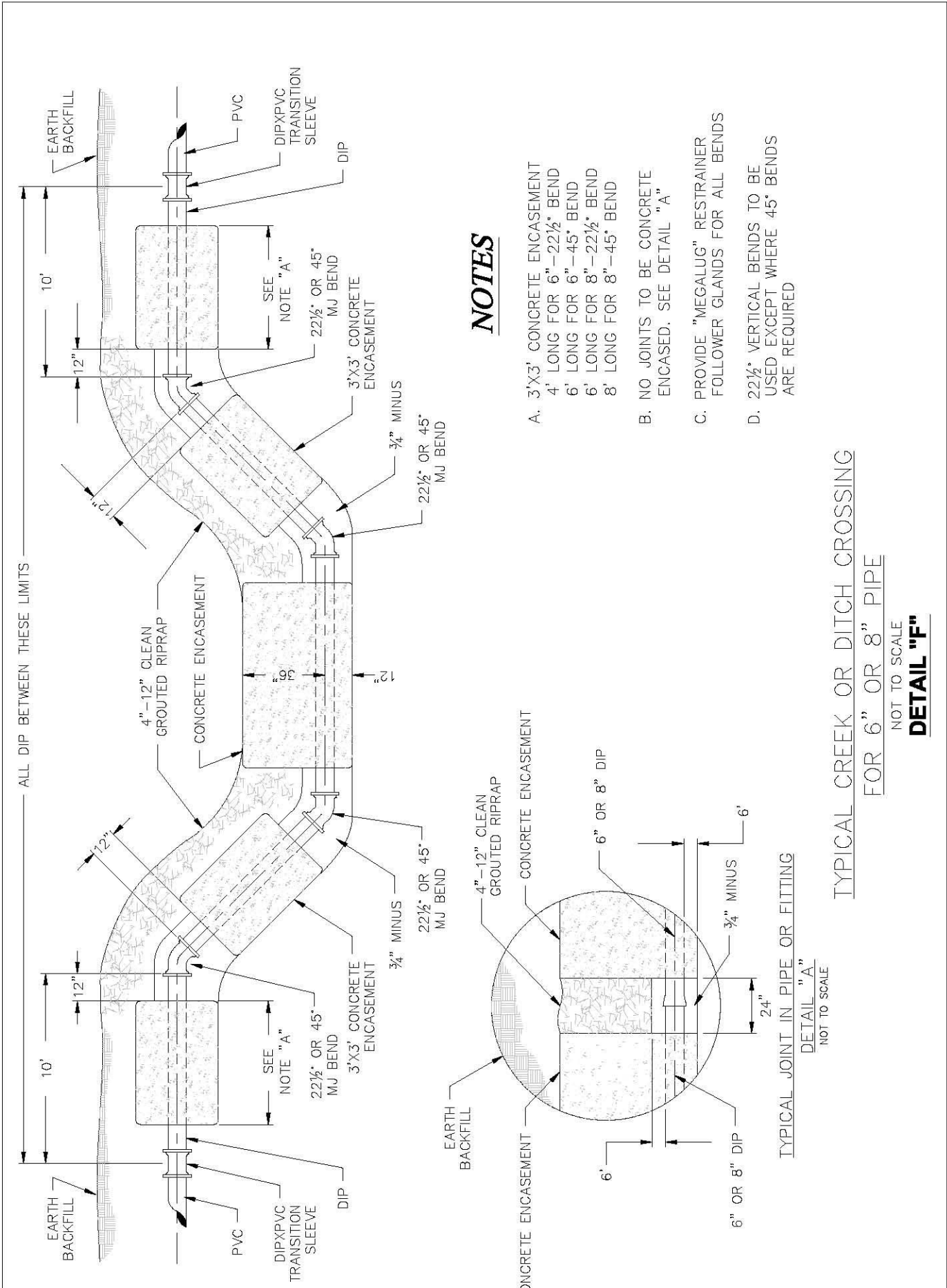
DIMENSIONS FOR VERTICAL BENDS
 (IN INCHES)
DETAIL "D"
 PAGE 2 of 2



MANUAL AIR RELEASE DEVICE

NOT TO SCALE

DETAIL "E"



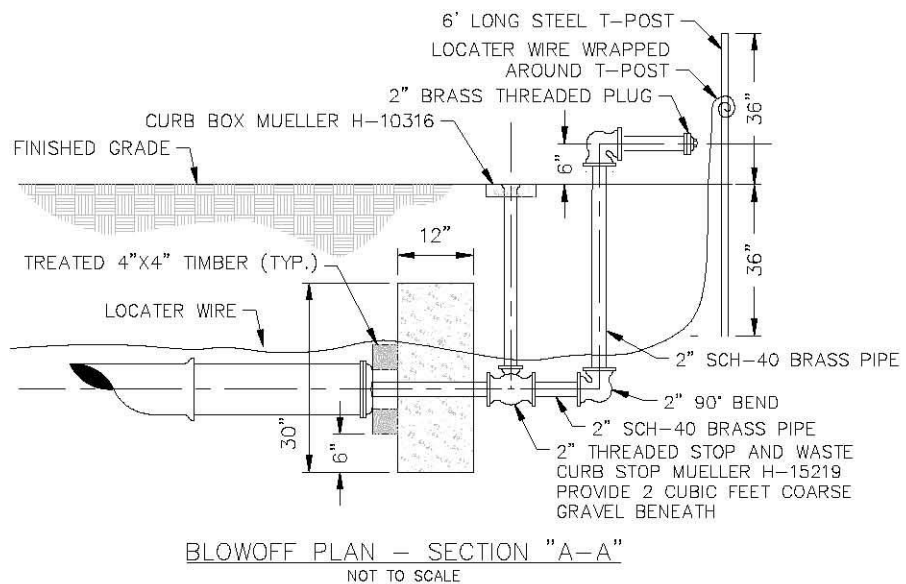
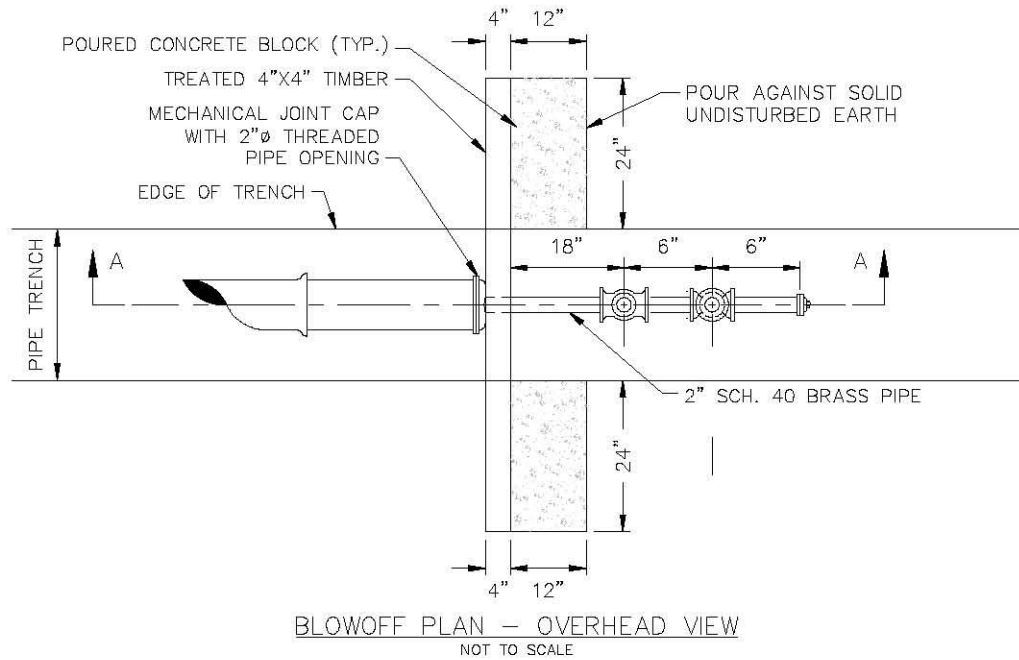
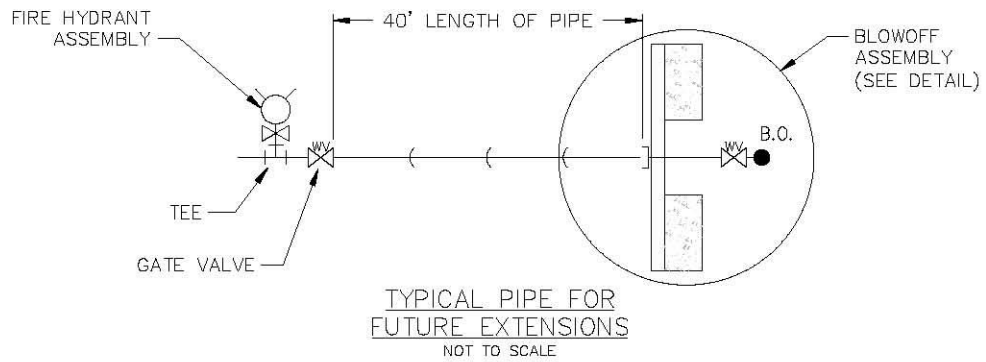
NOTES

- A. 3'X3' CONCRETE ENCASUREMENT
4' LONG FOR 6"-22½" BEND
6' LONG FOR 6"-45" BEND
6' LONG FOR 8"-22½" BEND
8' LONG FOR 8"-45" BEND
- B. NO JOINTS TO BE CONCRETE ENCASED. SEE DETAIL "A"
- C. PROVIDE "MEGALUG" RESTRAINER FOLLOWER GLANDS FOR ALL BENDS
- D. 22½" VERTICAL BENDS TO BE USED EXCEPT WHERE 45" BENDS ARE REQUIRED

TYPICAL CREEK OR DITCH CROSSING
FOR 6" OR 8" PIPE

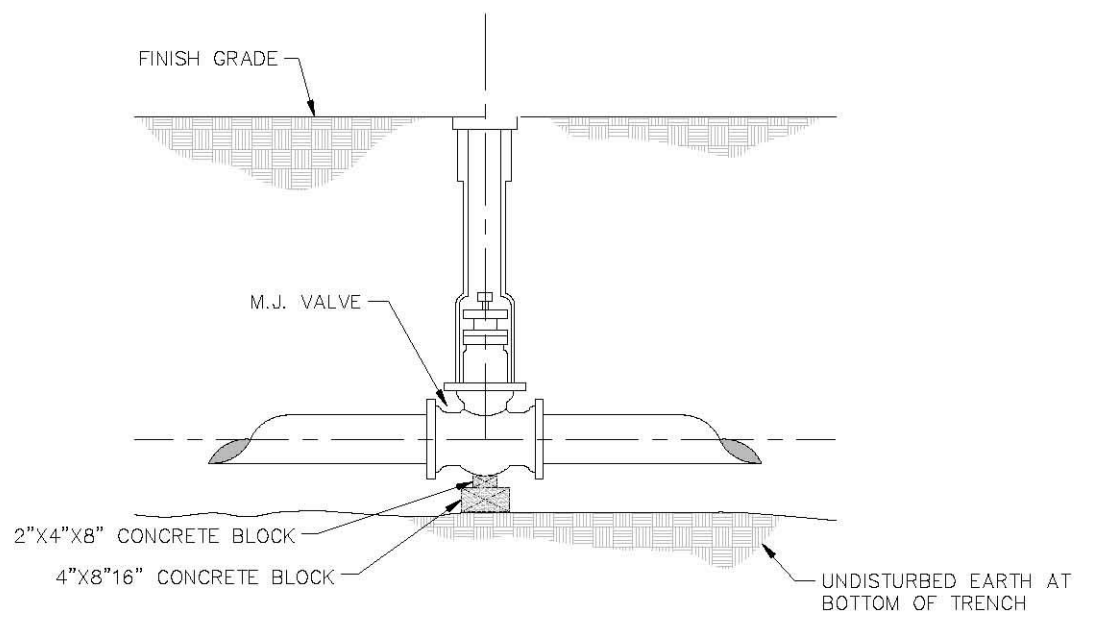
TYPICAL JOINT IN PIPE OR FITTING
DETAIL "A"
NOT TO SCALE

NOT TO SCALE
DETAIL "F"



TEMPORARY BLOWOFF INSTALLATION

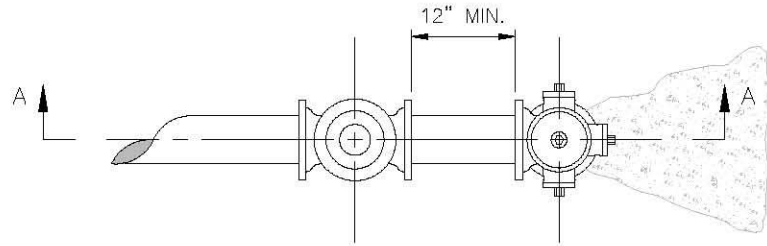
DETAIL "G"



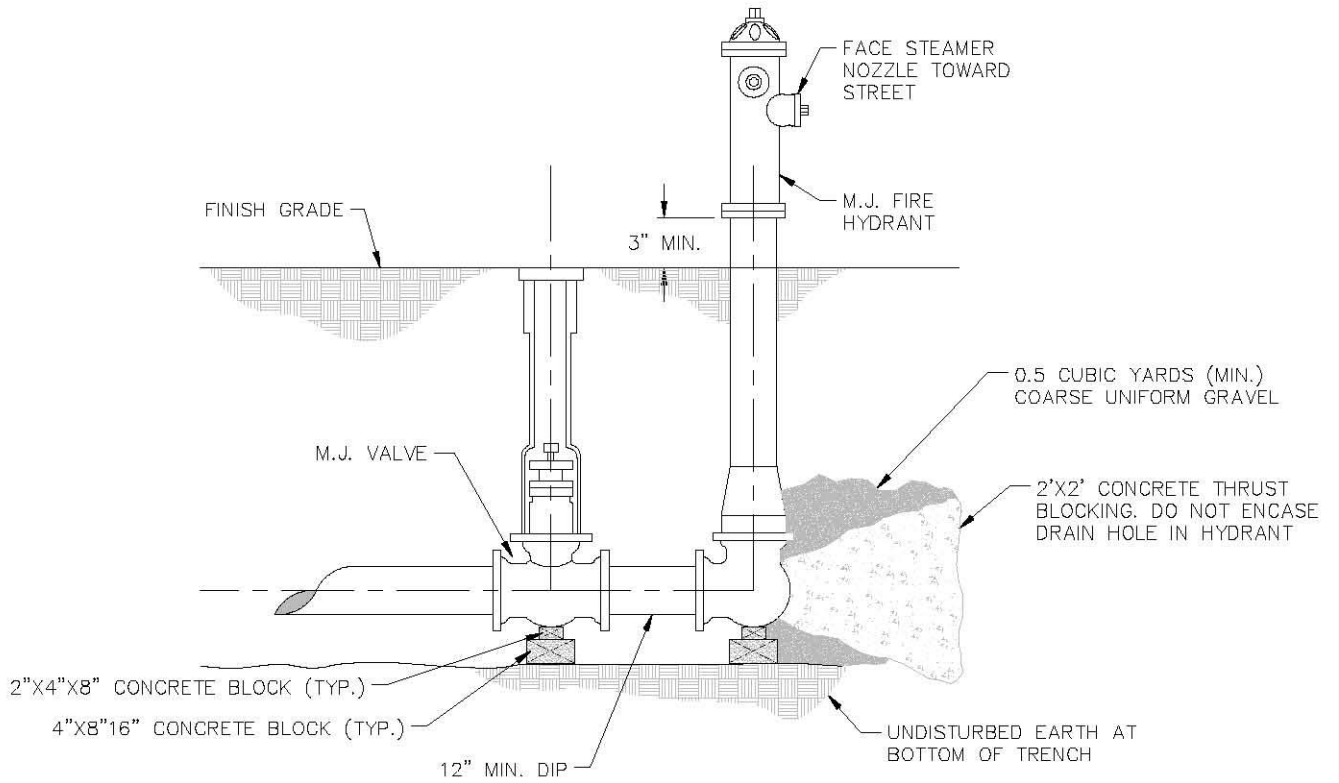
GATE VALVE DETAIL

NOT TO SCALE

DETAIL "H"



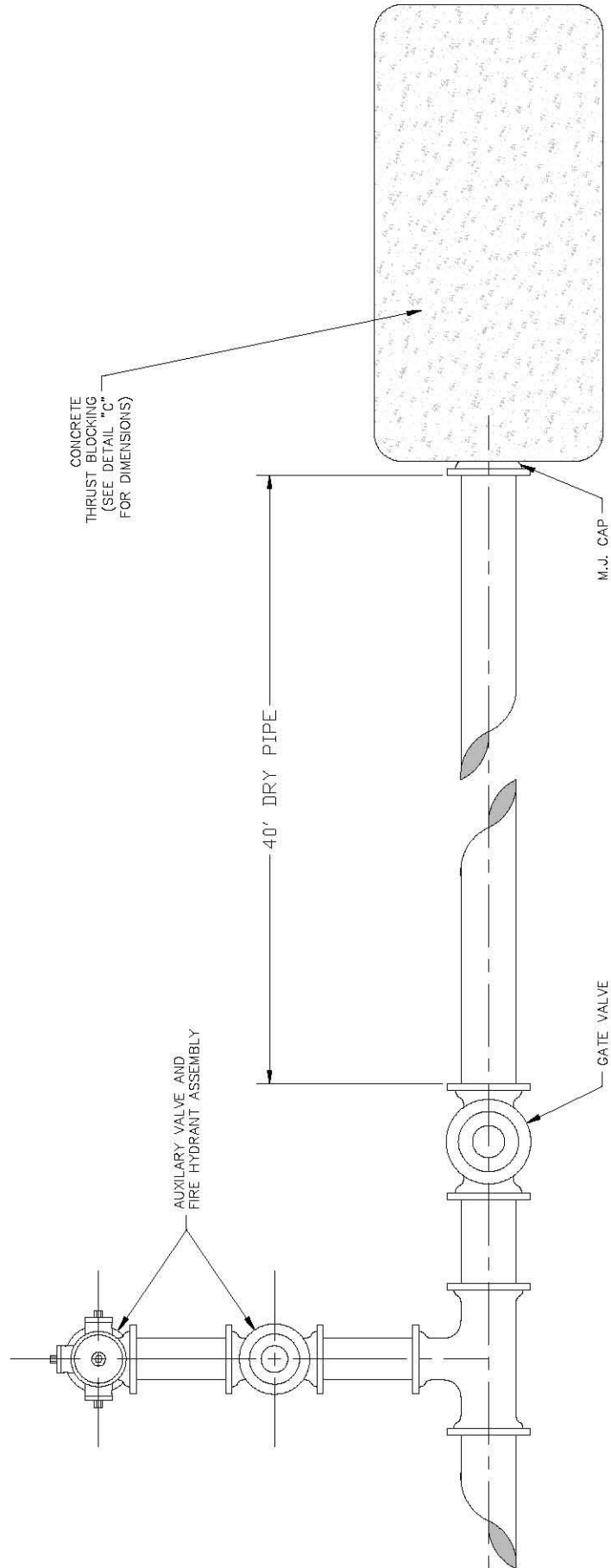
PLAN VIEW
NOT TO SCALE



SECTION "A-A"
NOT TO SCALE

FIRE HYDRANT DETAIL
AT TERMINATION IN
CUL-DE-SAC OR COURT

DETAIL "I"



PLAN VIEW
NOT TO SCALE