

**CITY OF MOBERLY, MISSOURI
SPECIFICATIONS FOR WATER MAIN CONSTRUCTION
EXTENSIONS AND/OR ALTERATIONS**

PART 1 - GENERAL

STATE REVIEW # 22146-04 MAY 04

1.01 AUTHORITY

- A. These specifications are prepared and approved by the City of Moberly Water Department, and shall be enforced and no part thereof altered without approval of the Water Superintendent or his duly appointed representative.

1.02 INTENT AND DEFINITIONS

- A. The intent of these specifications is to specify the type and quality of all water main and service materials, the installation requirements, the inspections and testing methods, and the terms of acceptance by the City of Moberly of any water main work, extension on any main or mains, or services, that will be an active part of the water system of the City of Moberly, Missouri.

B. Definitions:

1. City: City of Moberly, Missouri.
2. Water Department: Water Department of the City of Moberly, Missouri.
3. Engineer: The Director of the Water Department or his duly authorized representative.
4. Inspector: The technical representative of the City authorized by the owner or engineer, limited in each case to the particular duties entrusted to him or them.
5. Contractor: Any person or firm doing any type of work on a water main.
6. Owner: Any person owning rights to or sponsoring any work pertaining to water main work such as the City, a landowner, or developer.
7. AWWA: American Water Works Association.
8. AWWA: American Wood Products Association.

C. Method of Measurement and Basis of Payment:

1. Water Main: Water main will be measured along the centerline and paid for by the linear foot. Fittings, clean up and all required bedding and reaction backing are incidental to the pipe cost.

2. Service Lines: Service lines will be measured on a per each basis for services on the same side of a roadway as the water line or services pushed under the roadway.
3. Water Main Through Casing Pipe: Water pipe through casing will be measured along the centerline and paid for by the linear foot.
4. Valves and Box: Valve and box will be counted and paid for as a unit.
5. Hydrants: Hydrants, including valve, valve box, all piping accessories, and connections to the main will be counted and paid for by the unit.
6. Incidental Items: No separate payment shall be made for concrete encasement, bedding material, locator wire, marking tape, pipe fittings, joint restraint, disposal of excavated material, restoration of pavement, driveways, or other surfaces, seeding, bollards, or an other item not specifically listed above unless bid by separate line item.

1.03 RESPONSIBILITIES OF CONTRACTOR AND OWNER

- A. The owner and his engineer shall be responsible for the proper location and grade of any proposed extension. Location of any construction shall be shown on plan submitted to and approved by the City of Moberly and Missouri Department of Natural Resources for any public water line extension. Potential problems with sanitary sewers, manhole storm sewers and drop inlets must be shown in the plans and proper clearances provided for in accordance with the requirements of the State of Missouri.
- B. The contractor shall employ skilled workmen under the supervision of a foreman experienced in water construction or a licensed plumber to install main or services. The inspector may suspend work until, in his opinion, skilled personnel are provided.
- C. The developer or contractor shall be responsible for any failure of the main extension that can be attributed to faulty workmanship or defective materials and for maintenance of backfilled areas for one year after completion of the work. The completion date shall be established by the City based upon the report of the inspector.

1.04 SUBMITTALS

- A. Plans shall be submitted to the City of Moberly for review and approval of any public water main extension. These plans shall be prepared under the supervision of any engineer registered to practice in the State of Missouri and shall include pressure and flow data. Upon approval of the plans by the City of Moberly, it is the sole responsibility of the owner and his engineer to submit plans and permit application to the Missouri Department of Natural Resources for permit by the State of Missouri. No work may be done until a copy of the permit has been provided to the City.
- B. Plans shall include details of connections to existing water system, location of valves, hydrants and other facilities, and proposed location of water services. If any

materials that are proposed are different from those required in the specifications, shop drawing information shall be submitted to the City for their determination as to whether or not the material is equal and/or acceptable to the City. Submittal of the following may be required:

1. Color code for random length pipe shipped to job site.
 2. Affidavits of compliance with applicable standards.
 3. Test certificates.
 4. Special fitting detail.
 5. Joint details.
 6. Butt welding end preparation details.
 7. Laying schedule for mechanical thrust restraint for buried piping.
 8. Catalog data or illustrations showing principal parts and materials.
 9. Spare parts list.
 10. Assembly and disassembly or repair instructions.
- C. Upon completion of construction, the developer or contractor shall provide 8 copies of engineer certified as-built of location to the City for their permanent records, plus one digital copy on compact disk. This will include witnessing of service line locations and valves.
- D. The contractor is solely responsible for the procedures to flush the water line, provide pressure and leakage tests and chlorination. Methods shall be in accordance with the specifications unless approved by the City. Water will be supplied by the City of Moberly for the one test.

1.05 JOB CONDITIONS

- A. Interrupting Water Service:
1. Service to existing water customers shall not be interrupted unless approved by the City.
 2. If approval for an interruption of service is obtained, the contractor shall provide an eight-hour notification to all affected occupants and 24-hour notification to the fire department of the time and duration of the interruption.
 3. If it is determined that standby service may be required to be provided by the contractor. The outage shall not exceed four hours in duration.
 4. Operation of existing valves to close off the water system shall be done by the City's employees only.
 5. Contractor shall be solely responsible to prevent contamination of existing water lines.
- B. Scheduling:
1. Service lines shall not be installed until after the main has been tested and chlorinated.

2. Clean up shall occur promptly following water pipe installation and shall be kept within a maximum of 400 feet behind the pipe laying operation.

1.06 REFERENCES

A. Pipe, valves, materials, fittings, and other appurtenances shall be designed, fabricated, and tested in accordance with manufacturers' recommended procedures and the following codes and applicable standards:

1. American National Standards Institute (ANSI):

- A312 - Seamless and Welded Austenitic Stainless Steel Pipe.
- A21.4 - Cement Mortar Lining for Cast-Iron Pipe and Fittings for Water
- A21.10 - Gray-Iron and Ductile-Iron Fittings, 2 Inch Through 48 Inch, for Water and Other Liquids
- A21.11 - Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings
- A21.51 - Ductile Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids
- B16.3 - Malleable Iron Screwed Fittings, 150 and 300 Pound
- B16.10 - Face to Face and End to End Dimensions of Ferrous Valves.
- B16.11 - Forged Steel Fittings, Socket Welding and Threaded
- B16.22 - Wrought Copper and Bronze Solder Joint Pressure Fittings
- B16.25 - Butt Welding Ends
- B16.34 - Steel Butt Welding End Valves.
- B31.1 - Code for Pressure Piping, Power Piping Section.

2. American Society for Testing and Materials (ASTM):

- A48 - Gray Iron Castings
- A53 - Welded and Seamless Carbon Steel Pipe
- A105 - Forgings, Carbon Steel for Piping Components.
- A106 - Seamless Carbon Steel Pipe for High Temperature Service
- A120 - Black and Hot Dipped Zinc-Coated (Galvanized) Welded and Seamless Pipe for Ordinary Uses
- A126 - Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- A312 - Stainless and Welded Austenitic Stainless Steel Pipe
- A536 - Ductile Iron Castings.
- A674 - Polyethylene Encasement for Gray and Ductile Cast-Iron Pipe for water or other Liquids.
- A746 - Standard for Ductile Iron Gravity Service Pipe.
- B75 - Seamless Copper Tube
- B88 - Seamless Copper Water Tube
- C150 - Portland Cement.
- D212 - Installation of PVC Pipe
- D1248 - Polyethylene Plastic Molding and Extrusion Materials.
- D1784 - Rigid Polyvinyl Chloride Compounds and Chlorinated Polyvinyl Chloride Compounds.

- D2310 - Machine Made Reinforced Thermosetting Resin Pipe
- D2997 - Centrifugally Cast Reinforced Thermosetting Resin Pipe
- D3034 - Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings (4" through 15").
- F679 - Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings (18" through 27").
- D-638 - Test Method for Tensile Properties of Plastics.
- D-790 - Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- D-1238 - Test Method for Flow Rates of Thermal Plastics by Extrusion Plastometer.
- D-1248 - Specification for Polyethylene Plastics Molding and Extrusion Materials.
- D-1505 - Test Method for Density of Plastics by the Density Gradient Technique.
- D-1599 - Test Method for Short Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.
- D-1693 - Test Method for Environmental Stress Cracking of Ethylene Plastics.
- D-2122 - Method for Determining Dimensions of Thermal Plastic Pipe and Fittings.
- D-2837 - Method for Obtaining Hydrostatic Design Basis for Thermal Plastic Pipe Materials.
- D-3350 - Specification for Polyethylene Plastics Pipe and Fittings Material.
- F-1248 - Determination of Environmental Stress Crack Resistance (ESCR) of Polyethylene Pipe.
- D-4218 - Test Method for Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
- D-2737 - Polyethylene Plastic Tubing (Copper Tube Size; Outside Diameter).
- D-2239 - Polyethylene Plastic Pipe (SIDR-PR). (Iron Pipe Size; Inside Diameter).

3. American Water Works Association (AWWA):

- C104 - Cement-mortar Lining for Cast-Iron and Ductile-Iron Pipe and Fittings for Water.
- C105 - Polyethylene Encasement for Gray and Ductile Iron Piping for Water and Other Liquids
- C110 - Gray-Iron and Ductile-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids.
- C111 - Rubber-Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings.
- C115 - Flanged Cast-Iron and Ductile-Iron Pipe with Threaded Flanges.
- C150 - Thickness Design of Ductile Iron Pipe.
- C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- C153 - Ductile Iron Compact Fittings.

- C206 - Field Welding of Steel Water Pipe.
- C507 - Ball Valves, Shaft or Trunnion Mounted - 6-inch through 48-inch - for Water Pressures up to 300 psi.
- C508 - Swing Check Valves for Water Works Service.
- C511 - Reduced Pressure Principle Back Flow-Prevention Assembly.
- C550 - Protective Interior Coatings for Valves and Hydrants.
- C600 - Installation of Ductile Iron Pipe Water Mains and Appurtenances.
- C651 - Disinfecting Watermains.
- C900 - Polyvinyl Chloride Pressure Pipe.
- C901 - Polyethylene Pressure Pipe, Fittings, ½" through 3" for Water.
- C906 - Polyethylene (PE) Pressure Pipe and Fittings 4"-63", for Water Distribution.
- M11 - Steel Pipe Design and Installation.

4. American Society of Mechanical Engineers (ASME):

- B31 - Code for Pressure Piping.

B. Manufacturers shall be experienced in the design and manufacture of specific valves and accessories for a minimum period of 5 years.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Ship all random-length pipe to the job site marked with a continuous color stripe indicating material and schedule number.
- B. Handle and store pipe, valves, flanges, stems, operators, valve threads, and fittings with equipment having an adequate factor of safety against overturning, and in a manner to insure installation in an undamaged condition (such as use of slings, hooks and other devices). Do not drop or bump pipe or fittings.
- C. Ship all gaskets to the job site tagged with size, material and pressure rating, and spare gaskets packaged separately and tagged as spare parts.
- D. Ship all valves with suitable end covers to prevent entrance of foreign material into valve body.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General:
 - 1. Lead joints are not permitted.
 - 2. City only allows 6" mains and greater.

- B. Ductile Iron Pipe and Fittings: Ductile iron pipe and fittings shall conform to ANSI A21.50 and ANSI A21.51 and shall be class 52 or above.
1. Acceptable Manufacturers:
 - a. American Cast Iron Pipe Co.
 - b. U.S. Pipe Supply.
 - c. Or approved equal.
 2. Ductile iron pressure pipe shall conform to ANSI A21.50, ANSI A21.51, AWWA C115, C150, and C151 except as otherwise specified.
 3. Ductile Iron Pipe shall be used in commercial or industrial areas and may be used in residential areas.
 4. Joints:
 - a. All buried gravity pipe shall have push-on joints conforming to AWWA C111. Push-on joints shall meet ANSI A21.11.
 - b. Sleeved or coupled joints shall be provided where indicated. Furnish pipe ends suitable for installing style of sleeve or coupling indicated or specified. Provide anchor couplings or thrust blocks where restraint is required to withstand specified operating or hydraulic test pressure and where indicated.
 - c. Furnish restrained joints or thrust blocks where joint restraint is required to offset internal pipeline forces. Restrained joints shall be Flex Ring joint as manufactured by American Cast Iron Pipe Company, TR-Flex by U.S. Pipe, or equal. Joint restraint systems consisting solely of wedge elements in rubber gaskets will not be acceptable.
 5. Fittings:
 - a. Fittings shall conform to AWWA C110 or C153 and shall be ductile iron and bituminous coated. 12" and smaller fitting shall be 250 pound; 16" and larger fittings shall be 150 pound. Tee bolts shall be NNS core-10 or NSS core blue or equal.
 - b. Provide all specials, taps and plugs as specified or indicated.
 6. Lining:
 - a. All water line pipe and fittings shall be lined with cement mortar conforming to ANSI 21.4 and AWWA C 104, unless otherwise indicated.
 7. All buried iron pipe and fittings shall be coated with manufacturer's standard exterior enamel coating.

8. Gaskets and Bolting Material:
 - a. Provide all gaskets, bolts, lubricants, and other accessories required to install pipe and fittings complete and ready for service.
 9. Polyethylene Encasement: All buried ductile iron piping, valves, and fittings shall be installed with a polyethylene tube encasement conforming to ASTM D1248, Type 1, Class C, Grade E-1.
- C. Plastic Pressure Pipe and Fittings (PVC):
1. Acceptable Manufacturers:
 - a. Certainteed Corporation.
 - b. J-M Manufacturing Company, Inc.
 - c. Diamond Plastics.
 - d. Clow Corp.
 - e. Or approved equal.
 2. The materials of this pipe shall be uniformly blended with unplasticized polyvinyl chloride. Nothing used in its manufacture shall be injurious to humans or animals, nor shall it impart taste or odor to domestic water or in any manner alter the chemical content of waters flowing through the pipe. It shall consist of all new materials, and the manufacturer shall furnish a sworn statement that no reused or materials known as "mill shorts" were used in the manufacturer of the pipe or fittings. All pipe shall have superior high-tensile strength. Pipe shall conform to all requirements of commercial standards and ANSI and as specified on the drawings. The PVC pipe shall have an outside diameter equivalent to ductile iron pipe with gasket bell end coupling and conform to the following standard specifications:
 - a. AWWA C-900, Class 150, DR 18 for 12" or less
 - b. AWWA C0905, Class 235, DR 18 for >12"
 3. All plastic pipe shall be approved by and bear the National Sanitation Foundation seal of approval and will comply with the requirements for Class 12454-A or Class 12454-B virgin components as defined in ASTM D1784 with an estimated hydrostatic design basis (HDB) rating of 4000 psi (27.58 MPa) for liquid at 73.4°F (23°C). Pipe and fittings with elastomeric seal joints shall meet the requirements of ASTM D3139.
 4. Certificates of conformance with the foregoing specifications shall be furnished with each lot of pipe supplied.
 5. Joints:
 - a. Pipe shall be joined by push on joints with integral bell and ring.

- b. At no point in the pipe bell, including the recess groove for rubber rings, shall the wall thickness be less than that for the pipe barrel.
- c. Maximum laying length of pipe shall be 20 feet.
- d. All pipe shall have a guide mark on the spigot end to enable checking of adequate seating into bell.
- e. Furnish restrained joints or thrust blocks where joint restraint is required to offset internal pipe line forces.

6. Fittings;

- a. Acceptable manufacturers:

- 1) Harco
- 2) Sceptor

- b. Fittings for 6" – 8" PVC pipe shall be designed for use with PVC pipe as specified. Otherwise, fittings shall be ductile iron, as specified. Ductile iron fittings for plastic pipe shall have a pressure rating not less than the pipe.

D. Steel Casing Pipe:

- 1. Casing pipe shall be steel having a wall with thickness conforming to the following schedule:

Casing Diameter	Minimum Wall Thickness (Coated or Cathodically Protected)
6", 8", 10", 12"	0.188"
14", 16", 18"	0.250"
20", 22", 24"	0.3125"
26"	0.344"
28"	0.375"
30"	0.406"

- 2. All pipe shall conform to all applicable requirements of AWWA C200 and AWWA M11, and if fabricated shall be constructed of A36 steel with a minimum yield point of 36 KSI; or if manufactured shall conform to grade B with a minimum yield point of 35 KSI. All casing pipe shall be jointed with 360' welds. It shall be mill primed and coated with bituminous based coating before installation. Where coating is damaged during installation, it shall be repaired and replaced by thorough brushing or scraping to sound material and applying two coats of the coating material.

E. Service Tubing:

1. Copper Tube and Fittings:

- a. Copper service tubing shall be $\frac{3}{4}$ " minimum inner diameter and shall conform to ASTM B88 - Type K annealed and soft tempered for buried installations, or type L for above-ground installations.
- b. Fittings shall be wrought copper in accordance with ANSI B16.22, flared or compression type.

2. Plastic Tube and Fittings:

- a. Plastic service tubing shall be $\frac{3}{4}$ " minimum inner diameter and shall be plastic, 250 CTS, copper size.
- b. Fittings shall be flared or compression type with stainless steel stiffeners.

F. Valves:

1. Valve body shall be similar to the material of the pipe (for metallic pipe) in which it is installed and shall be one of the following:

- a. Carbon Steel - ASTM A216 WBC.
- b. Ductile Iron - ASTM A536.
- c. Stainless Steel - ASTM A182 316L.
- d. Cast Iron - ASTM A126 Class B.
- e. Bronze - ASTM B61.

2. Gate Valves

a. Gate valves shall conform to AWWA C-509:

- 1) Acceptable Manufacturers:
 - a) Mueller
 - b) American Flow 2500
 - c) U.S. 5000 Metroseal
- 2) Valves shall be super seal, resilient seat or equal, and have a minimum design working pressure of 200 psi.
- 3) Valves shall open counter clockwise and be non-rising stem.
- 4) Valves stems shall use double O-ring seals.
- 5) Buried valves shall have mechanical joint ends.
- 6) Bolts shall be stainless steel. Gaskets and seals shall be non-asbestos materials.

7) Buried valves shall be operated with a 2' x 2" nut and valve box unless a handwheel is indicated on drawings. Exposed valves shall have hand wheel operators.

8) All valves shall be NSF approved.

3. Tapping Valves

a. Tapping valves shall be same as gate valves except that they shall be equipped with a raised lip constructed in accordance with MSS-SP60 to provide for centering of the valve on the tapping saddle.

b. Tapping sleeves shall be manufactured from all stainless steel group 18-8, material 304 including sleeve, houslet neck, outlet flange, and all bolts and nuts; seal to be full, circumferential, gridded and approved for portable water; flanged outlets shall be indexed per MSS-SP60 to accept tapping valves with an ANSI 150 pound drilling IAW AWWA C207; neck to accept full size cutter.

G. Valve Boxes:

1. Valve boxes shall generally be three-section cast iron with lid marked water. Valve boxes shall be adjustable with screw-type shafts or as an alternative, a C900 PVC pipe riser may be utilized and a Clay and Bailey 2195 tophat valve box may be utilized, in non-traffic areas.

H. Service Fittings:

1. Corporation Stops Corporation stops on copper water services shall be Mueller Company Number H15020, H15008 or Ford Company number F1000-3.

2. Corporation stops for plastic services shall be Mueller Company number H15008, Haze Manufacturing Company number 5200-DF or Ford Company number F1000-4.

3. Corporation stops tie to PVC pipe must be provided with a saddle.

4. Copper shall be used under street pavements.

I. Concrete:

1. All concrete to be utilized for reaction backing, pavement repairs and other ancillary construction shall be pavement concrete in accordance with section 501 of the Missouri standard specifications for Highway construction.

J. Anchors, Inserts, Reinforcement:

1. All thread rod shall be 3/4" stainless steel with heavy hex nut, group 18-8, material 304, minimum yield strength of 70KSI, minimum tensile coated strength 100KSI. Nuts shall be hex head 3/4" stainless steel, group 18-8, material 304.

K. Service Clamps:

1. Service clamps shall be bronze double strap, with bronze or stainless steel parts, and shall have AWWA C800 threads.

L. Hydrants:

1. Acceptable Manufacturers:

- a. Mueller Company
- b. American Flow B84B
- c. U.S. Pipe and Foundry, Metropolitan 250, model 94

2. Hydrants shall conform to AWWA C502. The main valve shall be designed to open against pressure and of a material suitable for potable water service. The valve opening shall not be less than 5". Valve shall open counter clockwise. It shall be provided with a dry type bonnet with lubricant reservoir protected by O-ring or quad-ring seals.

Special operating threads are required on all hydrants meeting the following requirements: Hydrants shall be furnished with two hose nozzles with outside diameter 3.2182", inside diameter 2.985", and six threads per inch, and one pumper nozzle with outside diameter 4.8782" and with six threads per inch.

The hydrant shall provide for a minimum bury depth of 4' including extensions required for blow offs. It shall also be provided with traffic break off joint near the ground surface and mechanical joint bell on shoe.

Hydrants shall be three-way with pumper nozzle, unless approved by the City.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General Application: Use mechanical joint end valves for 3-inch and larger buried installation.
- B. Gate Valves: Comply with AWWA C600. Install buried valves with stem pointing up and with cast-iron valve box.
- C. Thoroughly clean and remove all shipping materials prior to setting. Operate all valves from fully opened to totally closed.

3.02 PREPARATION

A. Alignment and Grade:

1. Water mains shall be laid and valves, hydrants and fittings shall be placed in accordance with the approved plans. Install pipe of size, materials, strength class, and joint type with embedment indicated for plan location.
2. All pipes shall have a minimum of 42" of cover over the top of the pipe unless otherwise approved by the engineer.
3. If any deviations occur between the plans and field conditions, the contractor shall notify the City and obtain instructions to proceed where there is a discrepancy or an obstruction not shown on the plans.

B. Dead Ends: The dead end of a main shall have a fire hydrant, flushing hydrant or approved flush assembly for flushing purposes. Flush assembly shall be a 2" minimum for 6" and 8" mains and a 4" minimum for 10" and 12" mains.

A flush assembly shall include as a minimum: a gate valve and box of the same size as the water main; a reducer, 2-90 degree bends, the lower bend shall have a weep hole bedded in 1" clean rock and the upper bend shall have a solvent welded cap.

C. Ells, Tees, Plugs, and Hydrants: All fittings shall have thrust reinforcement either in the form of approved manufactured restraint, stainless steel rods, and/or a properly designed thrust block of concrete.

D. Water Mains Near Sewers:

1. Water mains shall be designed and laid at least 10' horizontally from any existing or proposed storm or sanitary sewer line. Should local conditions prevent a lateral separation of 10', water main may be laid closer than 10' to a storm or sanitary sewer line provided that the main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer line and at such an elevation that the bottom of the water main is at least 18" above the top of the sewer line. When it is impossible to obtain vertical or horizontal separation, the sewer line must be re-laid and constructed with ductile iron pipe. Backfill shall be of compacted clay to a minimum of 18" over/under the water main. In no case shall the water main and the sewer line share the same granular fill bed. No water pipe shall pass through or come into contact with any part of a sewer or sewer manhole.
2. Vertical separation: Where water mains must cross over or under storm drains or sanitary sewers, the water main must be laid at such an elevation that the bottom or top of the water main is at least 18" above or below the top or bottom of the sewer and the full length of the water main pipe must be centered over the sewer to be crossed so that both the joints will be equally distant from the sewer and as remote therefrom as possible. This vertical separation must be maintained for that portion of the water main located

within 10' horizontally of any storm drain or sanitary sewer that it crosses, said 10' to be measured as the shortest distance from the water main to the sewer at that point. Backfill shall be of compacted clay to a minimum of 18" above and below the outside dimension of the water main and for a horizontal distance of 10' from the sewer being crossed. In no case shall the water main and the sewer share the same granular filled bed.

- E. The entire length of the pipe barrel shall bear evenly on the subgrade. Do not lay on block unless pipe is to receive total concrete encasement.
- F. Carrier pipe in casing pipe: Carrier pipe shall be supported with a minimum of three full-length wooden skids mounted an equal distance apart around the pipe circumference. Manufactured plastic PVC supports may be utilized, provided they are placed in accordance with the manufacturer's recommendations for number and spacing.
- G. Cleaning Pipe and Fittings:
 - 1. General: All pipes, fittings, and joints shall be clean and have the interior free of foreign material and joint surfaces free of lumps and blisters. Interior of pipe valves and fittings at a connection to an existing line shall be swabbed with 4% chlorine solution prior to connection of the extension.
 - 2. Exclude entrance of foreign material if work is suspended or stopped. Close ends of pipe with snug-fitting closures. Do not let water fill the trench. Include provisions to prevent flotation should water control measures prove inadequate. Remove water, sand, mud, and other undesirable material from trench before removal of end cap. Perform only when weather and trench conditions are suitable. Do not lay in water.

3.03 INSTALLATION

- A. Size and Alignment: The trench shall be dug such that the pipe can be laid to the proper grade and alignment as shown on the plans. Width of trench shall be so as to have a minimum width of 12" greater than the outside diameter of the pipe. Bell holes in bedding shall be provided at each joint to permit the proper jointing and ensure the pipe is supported evenly along the entire length of the barrel. Excavation may be performed by trenching when deemed necessary by the City.
- B. Bracing and shoring: It is the sole responsibility of the contractor to maintain all work in compliance with the current Occupation, Safety and Health Act (OSHA standards). In addition, trenches including embankments shall be shored or otherwise supported when the trench is more than 4 ft. in depth. In lieu of shoring the trench sites above the 4 ft. level may be sloped to preclude collapse, but shall not be steeper than 1 ft. rise to each 1 ft. horizontal. In the event of any other possible hazardous or unstable trenching conditions suitable bracing or shoring shall be provided as necessary.

- C. Open trench: At no time shall there be more than 300' of trench opened in advance of pipe laying operations and this length of open trench may be shortened by order of the City.
- D. Rock excavation: If rock is encountered it shall be excavated at least 12" wider than the outside diameter of the pipe and 6" deeper than the average depth of the trench as required by existing topography. Any required undercut of the trench subgrade shall be restored to proper grade by filling and compacting with an approved material so as to insure a uniform bed along the entire length of the pipe barrel. Approved materials are clean finely divided soil, sand and crushed stone aggregate (95% passing ½ inch screen but not more than 10% passing a number 200 sieve).
- E. Pipe laying:
1. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench by means of ropes or mechanical equipment. Under no conditions may they be dropped or thrown.
 2. After placing a length of pipe in the trench the spigot end shall be centered in the bell. The pipe shall be joined in accordance with manufacturer's instructions and brought to the proper grade and alignment. The pipe shall be secured in place with the proper backfill material, tamped around and over it except at the bells. When possible, commence laying at the downstream end of line and install pipe with spigot ends in the direction of flow. Bells shall be in the direction of the laying operations.
 3. At noon, night or any other time work is delayed, the open end of the line must be covered.
 4. All joint deflections must be within the pipe manufacturers recommendations, which are hereby included in and made part of the specifications.
 - a. Ductile iron pipe joint deflection shall be limited to conform with AWWA C600.
 - b. PVC pipe may be deflected around curves so long as deflection is in the joint only. No strain shall be placed on the pipe for the purpose of deflection. Manufacturers may vary in the amount of deflection which can be obtained in the pipe joint and their specifications must be followed. In the absence of manufacturer's specifications 1.5° per 20' section of pipe will be permitted; this will result in a 6" deflection per 20 LF of pipe.
- F. Jointing:
1. All joints must be made as per the manufacturer's and AWWA specifications.
 2. Locate joint to provide for differential movement at changes in type of pipe embedment, impervious trench checks, and structures.

3. Clean and lubricate all joint and rubber gasket surfaces with lubricant recommended.
4. Utilize methods and equipment capable of fully homing or making up joints without damage.
5. Check joint opening and deflection for specification limits.
6. Special Provisions for Jointing Ductile Iron Pipe:
 - a. Conform to AWWA C600.
 - b. Visually examine while suspended and before lowering into trench.
 - 1) Paint bell, spigot, or other suspected portions with turpentine and dust with cement to check for cracks invisible to the eye.
 - 2) Remove turpentine and cement by washing when test is satisfactorily completed.

G. Cutting Pipe

1. Cut in neat manner without damage to pipe.
2. Ductile iron and steel pipe to be cut with a carborundum blade saw or other acceptable methods.
3. Remove burrs and sharp edges and smooth the pipe end by grinding.
4. Repair lining where required and as approved.

H. Closure Pieces:

1. Connect two segments of pipeline or a pipeline segment and structure with short sections of pipe fabricated for the purpose.
2. Location of joints, types of joints, and pipe materials and strength classifications shall comply with specifications.
3. May be accomplished with sleeve couplings:
 - a. Of length such that gaskets are not less than 3" from pipe ends.
 - b. Include spacer ring identical to pipe end such that clear space in closure does not exceed 1/4".

I. Remove plugs from existing pipe as indicated in order to complete connections to existing pipe. Removed plugs shall become the property of the City.

J. Furnish and install test plugs where necessary to properly complete required testing.

1. Test plugs shall be as manufactured by pipe supplier.

2. Plugs shall be push-on, flanged, mechanical joint or restrained as required for ductile iron pipe and shall be watertight against heads equal to the specified test pressure.
 3. Secure plugs in place to facilitate removal when required to connect pipe.
 4. Restrain plugs to fittings where indicated.
- K. Restrained joints or thrust blocks shall be installed where required to counteract internal pressure forces. All thrust restraint shall be designed based on the working pressure of the pipe and bearing pressure of the soil.
- L. Valves: Valves shall be located as designated by the City. Generally valves shall be located at intersections with other water lines, on both sides of railroads, waterway crossings and bridges, and at all fire hydrants.
- M. Polyethylene encasement: All valves and fittings shall be fully bagged with clear 8 mil (minimum) polyethylene wrap in accordance with AWWA C105.
- N. Anchorage:
1. Brace or anchor as required to prevent displacement after establishing final position.
 2. Plugs, caps, bends: All plugs, caps, tees, end valves, fire hydrant valves and bends, unless otherwise indicated on approved plans shall be anchored to prevent movement by providing suitable reaction backing in the form of concrete thrust blocks or approved manufactured restraints. Tie rods shall be installed in accordance with the following schedule:

OF TIE RODS REQUIRED FOR A CLOSED VALVE OR DEAD END

	6"	8"	10"	12"
5/8" rods	2	4	N/A	N/A
3/4" rods	2	2	4	4

- O. Backfilling:
1. Backfill in areas to be paved, including future street right-of-way, shall be compacted in such a manner to obtain 95% of maximum density at optimum moisture \pm as determined by ATM D 698. Outside areas to be paved shall be placed to obtain 90% of maximum density at optimum moisture \pm as determined by ATM D 698.
 2. If PVC pipe is utilized, solid 1-#12 AWG high molecular weight polyethylene tracer wire (blue in color) shall be provided.
 3. Under the pipe: All backfill under the barrel of the pipe shall be free from debris, organic matter and stones larger than 1" in greatest dimension and shall be tamped into place. Sand or crushed stone aggregate 95% passing

½" screen but not more than 10% passing a number 200 sieve may be used only with the permission of the City.

4. Backfill over top of pipe: The first 1' of backfill over the top of pipe shall be free of debris, organic matter and stones larger than 3" in greatest dimension and shall be hand placed. If excavated material is not suitable for backfill, the City may require imported material to be used, including clean finely divided soil. If the material in the banks of the trench is suitable it may be used.
5. If the depth of the trench is over 5', at least 2' of hand placed fill must be placed over the top of the pipe before a mechanically tamped fill may be used.
6. Improved areas: Backfill of trenches under any paved area such as street, driveway, parking lot, or sidewalks shall be 1" clean gravel and shall include the restoration of these surfaces to the satisfaction of the City. Repair of existing surface shall be done to a manner that is equal to or better than the existing and shall be done in accordance with the details at the end of this section.
7. Maintenance of backfilled areas: The owner or developer shall provide for the contractor to maintain the backfilled areas to the grade of the surrounding terrain for a period of one year after completion of his respective contract. Seeding shall be to the satisfaction of the adjacent property owners.
8. Clean up: Upon completion of contract, contractor shall remove all excess materials or supplies and shall clean up the entire working area and dress the land so as to leave a neat, accessible work area. Any ditches, road or street shoulder shall be restored to their original alignment and grade.

P. Boring and Jacking:

1. General: The conduit shall be installed by jacking into place. Earth displaced by the conduit shall be removed through the interior of the conduit by hand, by auger, or by other acceptable means. Sections of the casing pipe shall be welded together to form a continuous conduit capable of resisting all stresses, including jacking stresses. The casing pipe conduit, and its final position, shall be straight and true in alignment and grade, as required by the drawings. There shall be no space between the earth and the outside of the casing.
2. Excavation: The contractor shall provide temporary support of pit facings as necessary to protect personnel in accordance with these specifications.
3. Casing pipe shall be in accordance with Section 2.01.L of these specifications.
4. Utilities: It is the contractor's sole responsibility to verify the location of other utilities that his casing pipe may cross. It is the contractor's responsibility to

provide adequate clearance from said utilities. Any damage to any utilities shall be repaired by the contractor at his expense.

5. Skids: Wood skids shall be provided as indicated on the detail found at the end of this section, or PVC casing spacers may be utilized.

- a. If wood skids are utilized the wood shall be treated with creosote, pentachlorophenol, or salt-type preservative in accordance with AWPA C2. Cut surfaces shall be given two heavy brush coats of the same preservative. Wood skids shall be securely strapped to the pipe with steel strapping material at least $\frac{3}{4}$ " wide.

After installation of the pipe with wood skids stabilized sand backfill shall be placed in the pipe filling the entire annular space between the pipe and the casing walls. Stabilized sand shall be used for this purpose and shall be mixed in proportions of at least 282 pounds of Portland cement for each cubic yard of sand. Cement, sand (fine aggregate), and water shall be thoroughly mixed in a mechanical mixer and shall contain only enough water to produce an easily handled mixture. Stabilized sand shall be blown into the casing in such a manner that all space is filled.

- b. PVC casing spacers may be used. If utilized they shall be attached to the pipe with stainless steel straps used to center the water main within the casing. The casing spacers shall be as manufactured by Cascade Water Works Manufacturing Company, of Yorkville, Illinois or approved equal. The spacers shall prevent appreciable movement of the pipe up, down or sideways within the casing. Two pairs of spacers shall be used on each length of pipe within the casing. The steel strapping material shall be at least 3" wide. When spacers are used, sand does not need to be blown into the annular space between the pipe and the casing.

6. End Closure: Each end of casing shall be sealed with brick and mortar bulkhead or other engineer approved method.

3.04 TESTING AND INSPECTION

A. General:

1. Generally, all work shall be inspected by the City prior to backfilling of lines.
2. Contractor shall notify the City and arrange for inspection and observation of all testing prior to test occurring.
3. Connections to existing mains: Under no conditions will any party or parties make any taps or connections to an existing main without the approval and presence of the City's Representative. Taps will be coordinated by the contractor.

4. The Contractor shall furnish all pumps, piping, labor and other materials and services necessary to bring the piping up to the specified test pressure. Pipe in the sections to be tested shall be backfilled or center loaded, with thrust blocks installed and completely backfilled.
5. Final Test: After required test procedures are completed and main is connected to the existing system, it shall be subjected to normal working pressure. If at any time within one year of final inspection, any trouble or failure in the respective line or lines occur that can be directly attributed to faulty workmanship or defective materials, it shall be the owner's financial responsibility to repair.

B. Hydrostatic Pressure Test:

1. The Contractor shall furnish all pumps, piping, labor and other materials and services necessary to bring the piping up to the specified test pressure. Pipe in the sections to be tested shall be backfilled or center loaded, with thrust blocks installed and completely backfilled.
2. After the pipe has been laid and partially backfilled, test connections shall be made and the pipe filled with water. After air removal, water shall be pumped in to bring the pipe to the specified pressure.
3. Unless otherwise specified, a pressure of not less than 1.5 times the normal operating pressure (for the lowest point on the pipe line) but not less than 150-200 pounds per square inch (psi) at the lowest point in the line or not more than the rated working pressure for the pipe shall be used for testing for a period of one hour.
4. The contractor will be responsible for this test. The contractor must immediately correct any defects in pipes, valves, fittings or hydrants and successive pressure test shall be run until satisfactory to the City.

C. Leakage Test:

1. Leakage: After successful completion of the aforesaid pressure test, a leakage test shall be run. Leakage test shall be maintained for a period of at least 18 hours under a pressure of 100 PSI at the lowest point in the line. All lines shall meet the AWWA leakage standards as shown in the following chart and said chart is hereby made a part of these specifications.

ALLOWABLE LEAKAGE FOR DUCTILE IRON AND
PVC PIPE

Allowable Leakage per 100 Joints - gph

Average Test Pressure PSI	Pipe Diameter --- Inches			
	6	8	12	16
100	1.62	2.16	3.24	4.32
125	1.82	2.42	3.65	4.83

150	1.99	2.64	3.96	5.29
200	2.29	3.06	4.59	6.11
225	2.43	3.24	4.85	6.48
250	2.56	3.42	5.12	6.83

2. All exposed pipe, fittings, valves, hydrants and joints shall be inspected and all evidence of moisture appearing on the surface of the ground during the test shall be investigated by the Contractor by excavation where the pipe has been covered with backfill. Should the leakage test results exceed allowable leakage, the test pressure shall be maintained for an additional period of time as directed by the Engineer to facilitate location of leaks.
3. All pipe, fittings, valves, pipe joints, hydrants, and other materials which are found to be defective when the pipe line is tested shall be removed from the line immediately and replaced with new and acceptable material by and at the expense of the Contractor. The pressure and leakage tests shall be repeated after repairing leaks and other defective work until the pipe line installation conforms to specified requirements and is accepted by the Engineer.

3.05 DISINFECTION

- A. Clean and disinfect potable water distribution piping as follows:
 1. All disinfection, chlorination and flushing of the main will be done by the contractor and shall meet AWWA standard C651. A copy of AWWA C651 may be found at the end of this section.
 2. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired, prior to use.
 3. The contractor shall furnish and place disinfecting material, preferably a 70% hypochlorite tablet in the mains as pipe is laid. Disinfecting material shall be placed in the manner in an amount as specified by the engineer. Following disinfection and flushing, the City shall collect bacteriological samples. Water from the new main shall remain isolated from other waters of the City system and shall not be made available for consumption until bacteriological testing indicates that the water meets drinking water standards of the Missouri Department of Natural Resources.

3.06 INSPECTION

- A. It shall be agreed to by all parties that the water department of the City of Moberly shall have authority of inspection at all times during the progress of any water main work. The inspector shall have full authority to inspect the materials and the work performed.
- B. The contractor shall furnish all reasonable aid and assistance required by the City or its representatives for the proper inspection and examination of the work and parts thereof.

- C. The contractor shall regard and obey the directions and instructions of the City or the City's inspector when the same are consistent to his contract or these specifications; however, should the contractor object to any order given by any inspector, he may object by written appeal to the water department of the City of Moberly or its duly appointed representative.
- D. Supervising engineers, inspectors and other properly authorized representatives of the owner or City shall be free at all times to perform their duties. Intimidation or attempted intimidation of one of them by the contractor or any of his employees shall be sufficient reason, if the City so desires, for suspension of work.
- E. Such inspections shall not relieve the contractor or owner from any obligations to perform his work in accordance with these specifications or any approved plans, and work not so constructed shall be removed and made good by the contractor or owner at his own expense, whenever ordered by the inspector, without reference to any previous oversight or error in inspection.
- F. Inspection for acceptance of pipe will be conducted by the Engineer as soon as practical after arrival of pipe and fittings at the job site.
- G. Job site inspection takes precedence over any prior inspection.

3.07 ACCEPTANCE

- A. Pipe will be inspected by Engineer for acceptance by owner at the construction site. Acceptance at the job site shall be paramount. Prior approval or payment for pipe rejected at the job site shall be null and void. Acceptance by Engineer at a point in the sequence of manufacture, delivery and installation will not relieve the Contractor of his responsibilities as set forth in the Contract Documents. Manufacturing defects that prohibit installed pipe from successfully passing leakage tests shall constitute rejection of the defective pipe.

3.08 PAVEMENT REPAIR

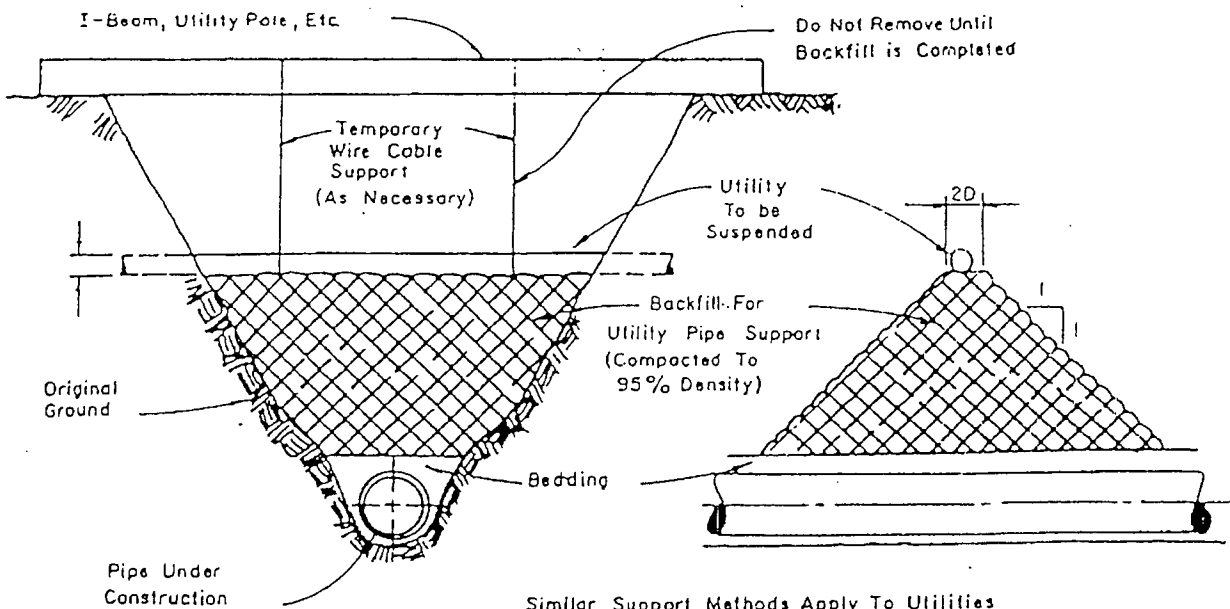
- A. Repair of paved surfaces shall be done in accordance with the details at the end of this section. Any paved surface that is removed for construction of water mains shall be repaired to a level equal to or better than the existing abutting surfaces. Open cutting of crossings in existing public roadways will generally not be permitted. Bored and jacked casings for main lines and pushing of services shall be required under these surfaces.

3.09 STANDARD DETAILS

- A. Special supports for underground utilities.
- B. Pipe saddles.
- C. Pipe Installation Details.

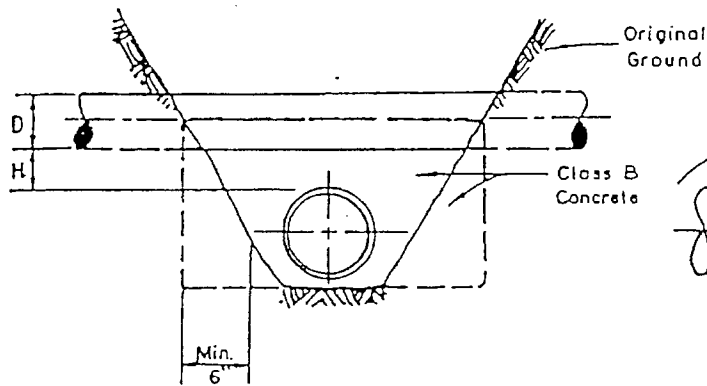
- D. Typical Hydrant and Valve Locations
- E. Thrust Block Details
- F. Fire Hydrant Detail
- G. Typical Bore & Encasement Detail.
- H. Road Crossing Restoration Detail
- I. Gate Valve Installation
- J. Line Termination Detail
- K. Driveway Crossing Restoration Detail
- L. Concrete Encasement Detail
- M. Creek Crossing Detail
- N. 5/8" x 3/4" Meter Setting and Service Connection

END OF SECTION



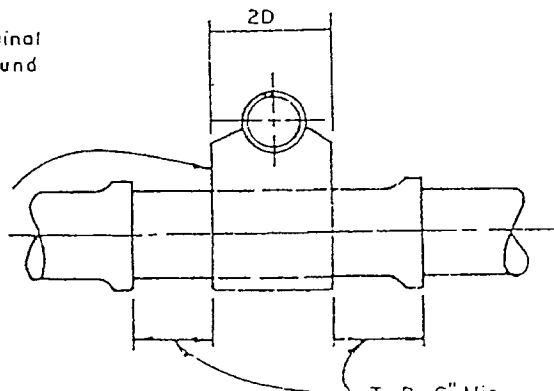
Similar Support Methods Apply To Utilities Paralleling and above the Pipe Under Construction

SPECIAL SUPPORTS FOR UNDERGROUND UTILITIES



SADDLE REQUIREMENTS

H	D
0" To 3"	Less than 15"
0" To 6"	18" Thru 36"
0" To 12"	42" and Over

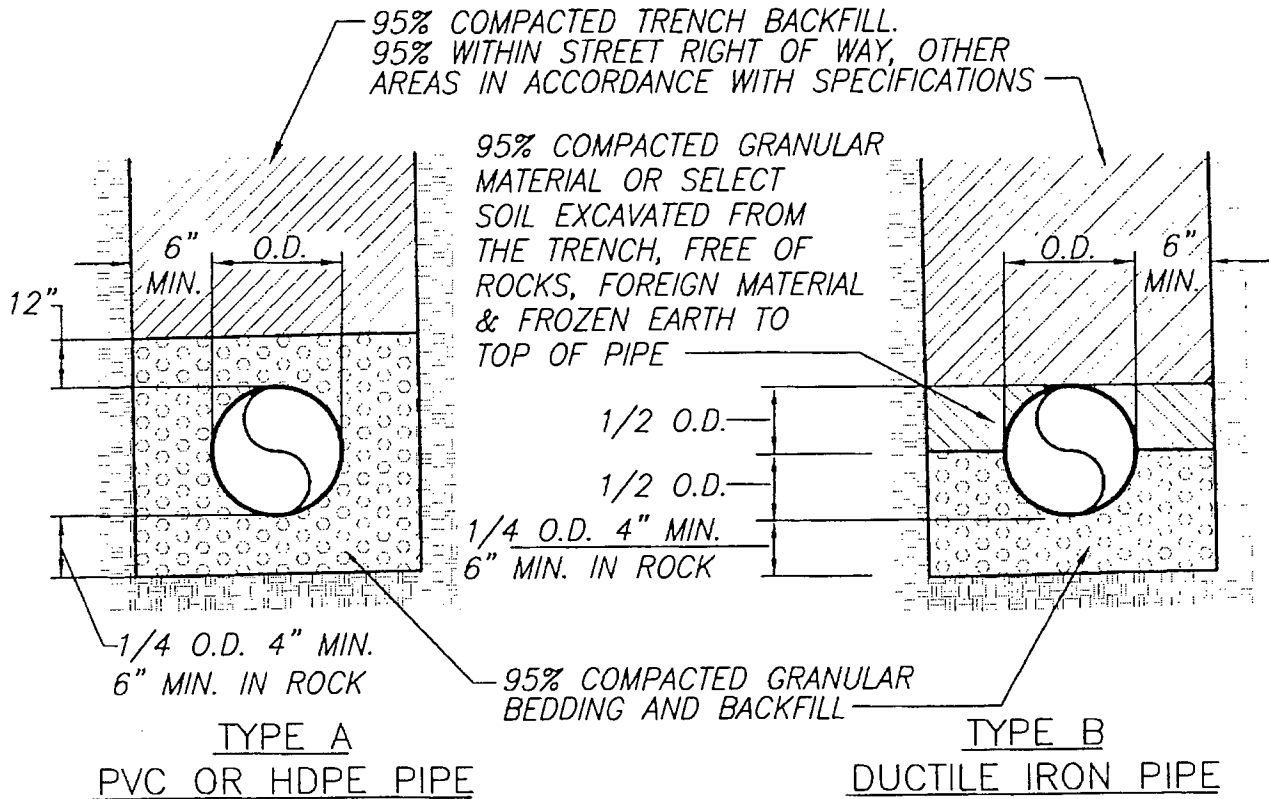


On Asbestos Cement, Unreinforced Concrete and Clay Pipe.

Not Required:
Plastic, Steel, Lead or Copper
Pipe 2" Or Smaller

* If Pipe Being Crossed is Sanitary
"H" Shall be Min 18"

PIPE SADDLES



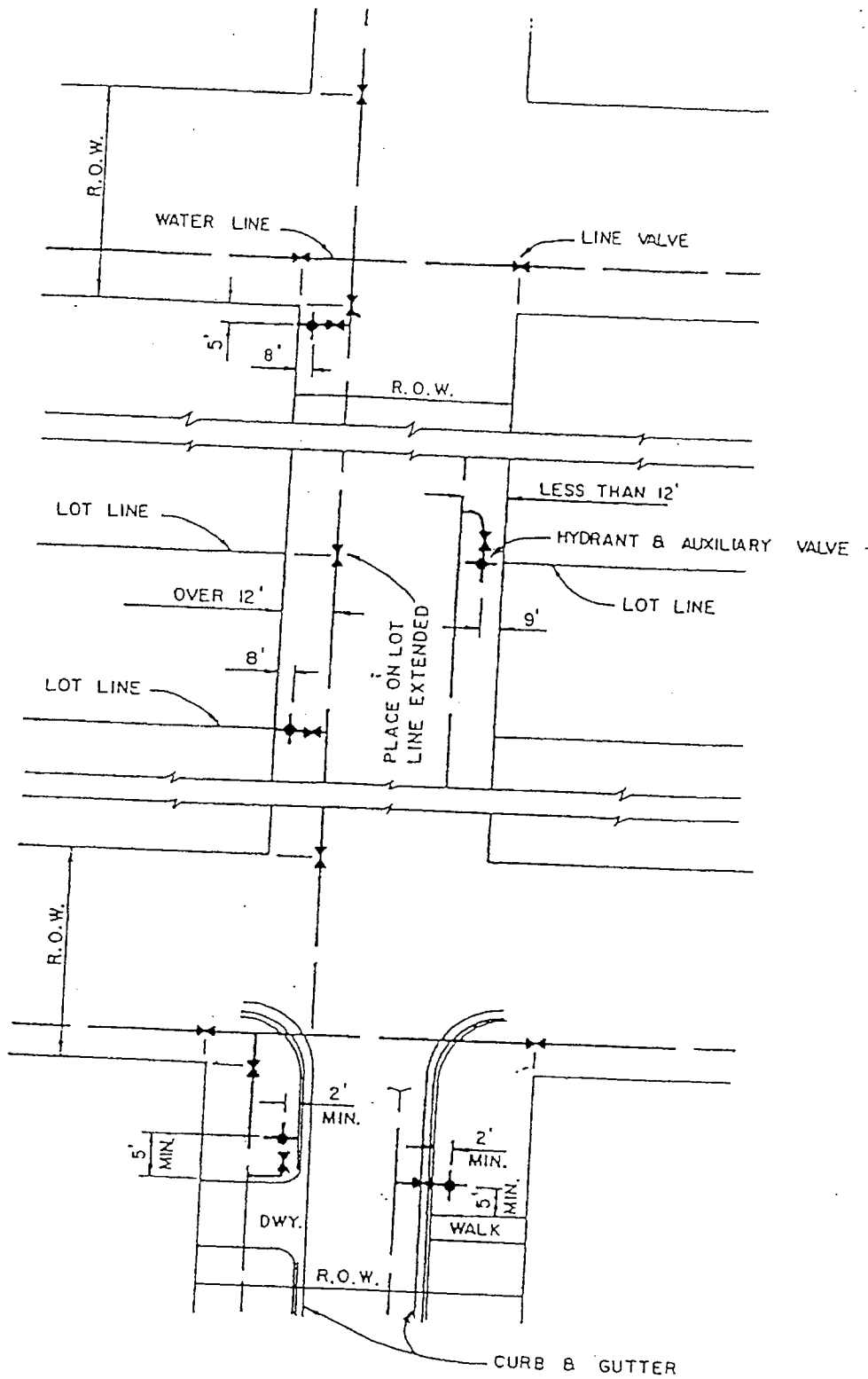
NOTES:

1. UNDERGROUND MARKING TAPE MARKED "CAUTION WATER LINE BURIED BELOW" BY TERRA TAPE OR APPROVED EQUAL, LOCATED 12" BELOW FINISHED GRADE.
2. TRACER WIRE FOR WATER LINE PIPE
HIGH MOLECULAR WEIGHT - POLYETHYLENE TRACER WIRE,
1-#12 AWG, BY PAIGE ELECTRIC OR APPROVED EQUAL. SPLICING
SHALL BE WITH 3M DBY/DBR DIRECT BURY SPLICE KITS.
TRACER WIRE LEAD CONNECTIONS TO BE LOCATED IN
GATE VALVE BOX AS SHOWN IN TYPICAL GATE VALVE
INSTALLATION DETAIL.
3. PIPE SHALL BE INSTALLED WITH A MINIMUM 42" COVER.

PIPE INSTALLATION DETAILS TYPICAL

NOT TO SCALE

DETAIL C

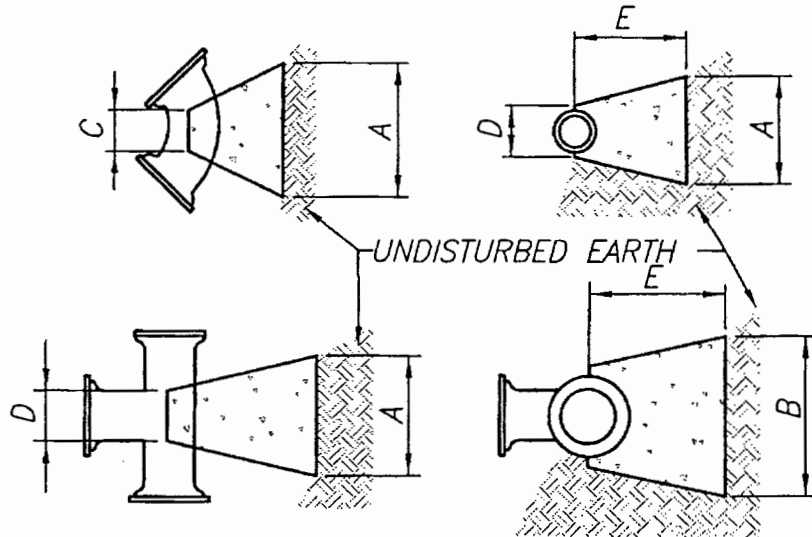


TYPICAL
HYDRANT AND VALVE LOCATIONS

PIPE SIZE	FITTING	DISTANCE IN INCHES				
		A	B	C	D	E
4" AND SMALLER	11.25 & 22.5°	9	9	8	8	6
	45°	18	9	8	8	12
	90°	21	12	8	8	12
	TEE/PLUG	15	12	8	8	12
6"	11.25 & 22.5°	12	12	8	10	12
	45°	27	12	8	10	12
	90°	33	18	8	10	12
	TEE/PLUG	24	18	8	10	12
8"	11.25 & 22.5°	18	15	8	10	12
	45°	33	15	8	10	18
	90°	42	24	8	10	18
	TEE/PLUG	30	24	8	10	18
10" & 12"	11.25 & 22.5°	27	24	12	12	18
	45°	51	24	12	12	24
	90°	63	36	12	12	30
	TEE/PLUG	45	36	12	12	24
14" & 16"	11.25 & 22.5°	33	33	12	16	18
	45°	69	33	12	16	30
	90°	84	48	12	16	36
	TEE/PLUG	60	48	12	16	30

NOTES:

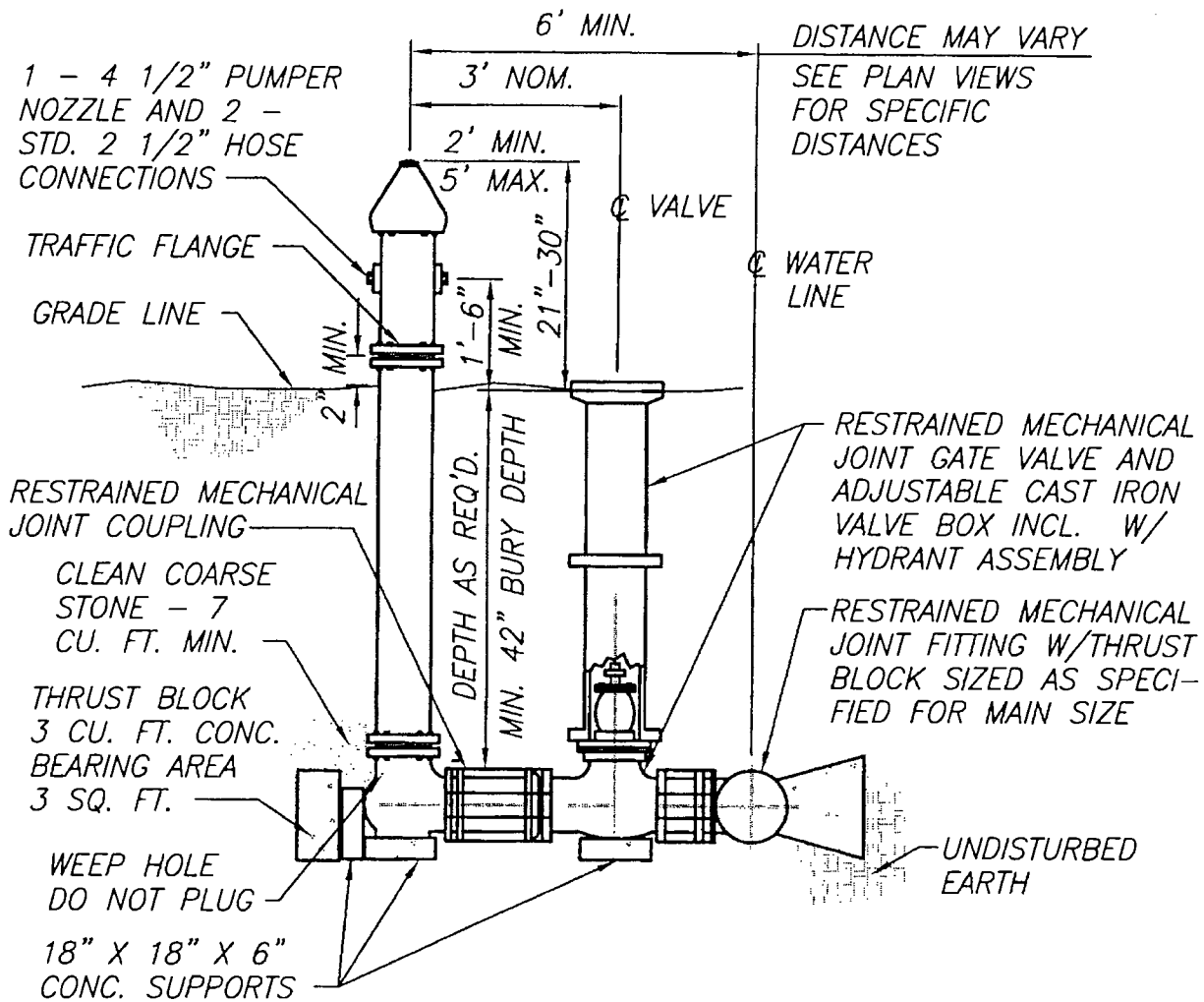
1. THRUST BLOCKS ARE BASED ON A WORKING PRESSURE OF 200 P.S.I., PLUS 0% SURGE, & 2000 P.S.F. ALLOWABLE SOIL BEARING PRESSURE.
2. FOR PIPE SIZES NOT SHOWN USE DIMENSIONS FOR NEXT LARGER SIZE.
3. USE 3/8" PLYWOOD SEPARATOR BETWEEN BLOCKS AND PLUGS TO PROVIDE FOR FUTURE REMOVAL.



CONCRETE THRUST BLOCK DETAIL

NOT TO SCALE

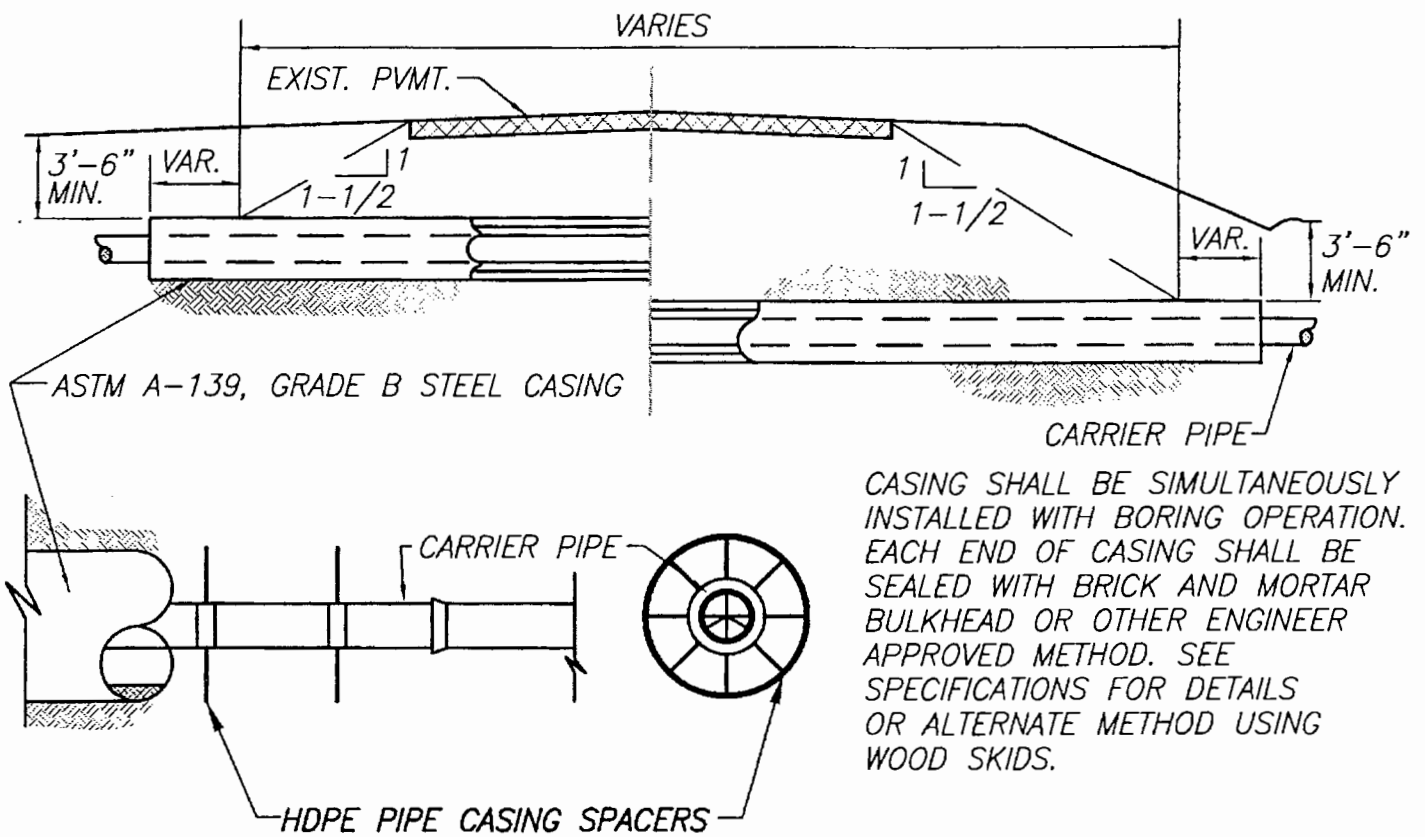
DETAIL E



FIRE HYDRANT DETAIL

NOT TO SCALE

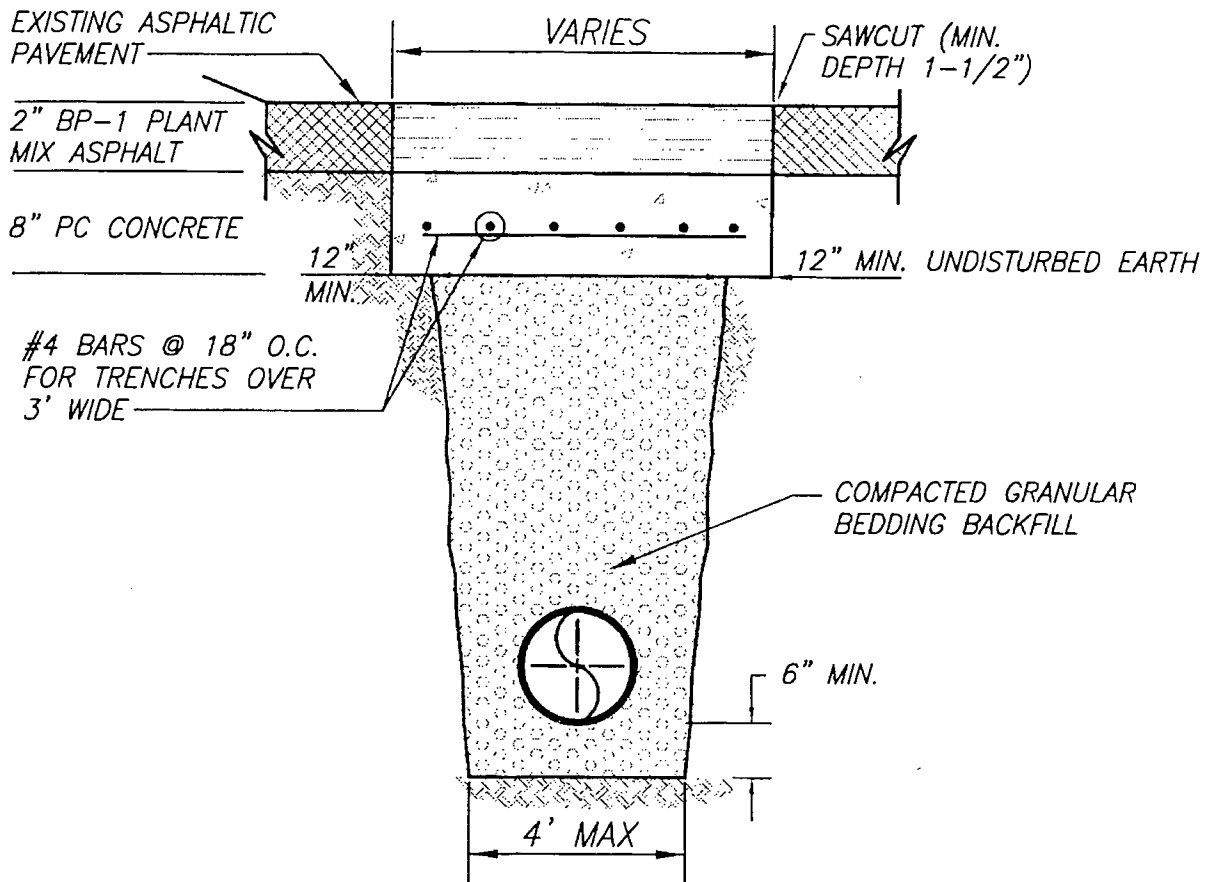
DETAIL F



TYPICAL BORE & ENCASEMENT DETAIL

NOT TO SCALE

DETAIL G

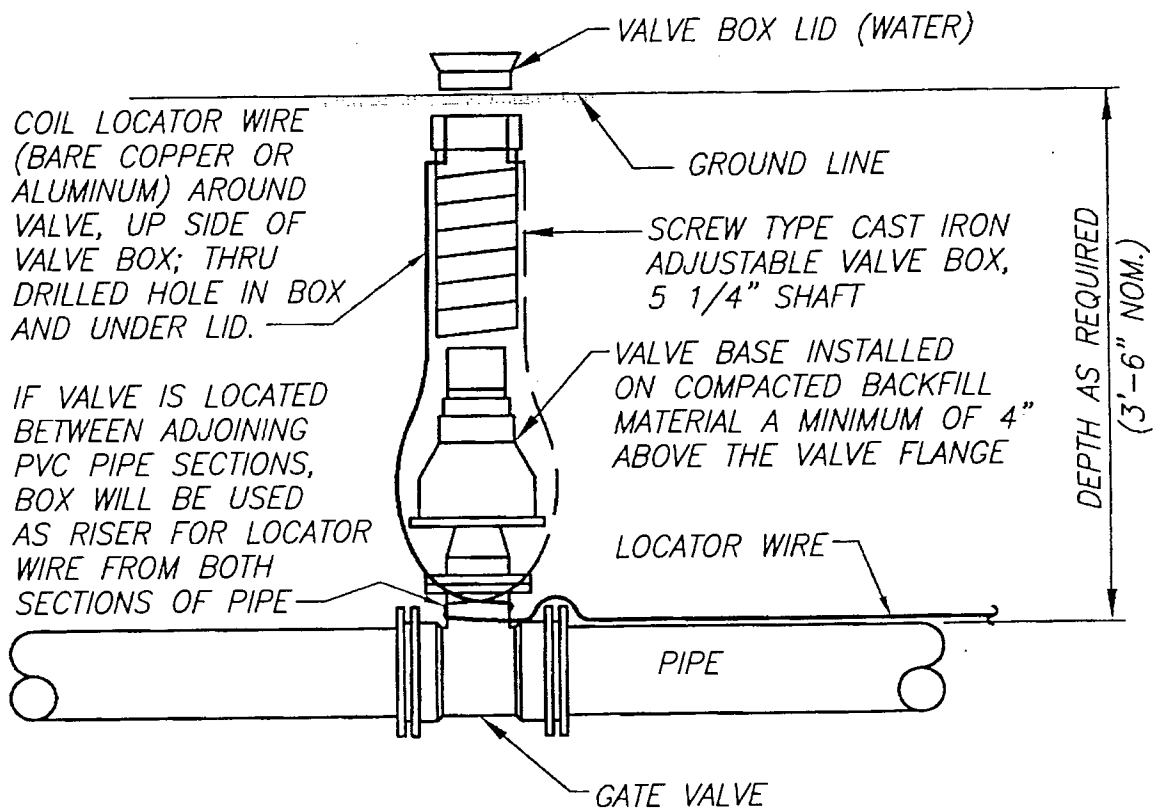


1. SAW CUT SHALL BE CONTINUOUS WITH SMOOTH, TAPERED TRANSITIONS IN WIDTH IN ORDER TO MAINTAIN A CONSISTENT PAVEMENT RESTORATION WIDTH.
2. ASPHALT IS NOT USED ON EXISTING PC CONCRETE SURFACES. IN THESE AREAS, SURFACE OF CONCRETE SHALL MATCH EXISTING.
3. HIGHWAY PAVEMENT REQUIRES MIN 8" CONCRETE, AS SHOWN, REGARDLESS OF EXISTING THICKNESS OF PAVEMENT

ROAD CROSSING RESTORATION DETAIL

NOT TO SCALE

DETAIL H

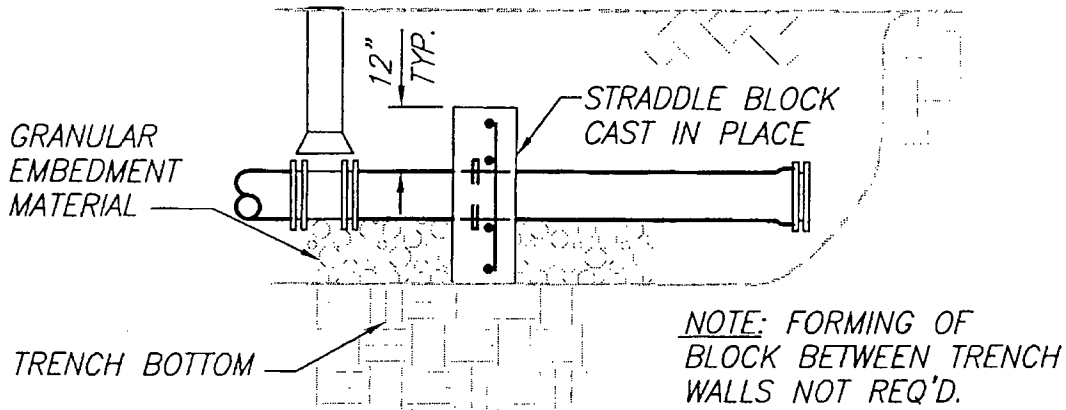


NOTE:
 WHERE GATE VALVES ARE INSTALLED ADJACENT TO TEES, GATE VALVES SHALL BE RESTRAINED BACK TO TEE.

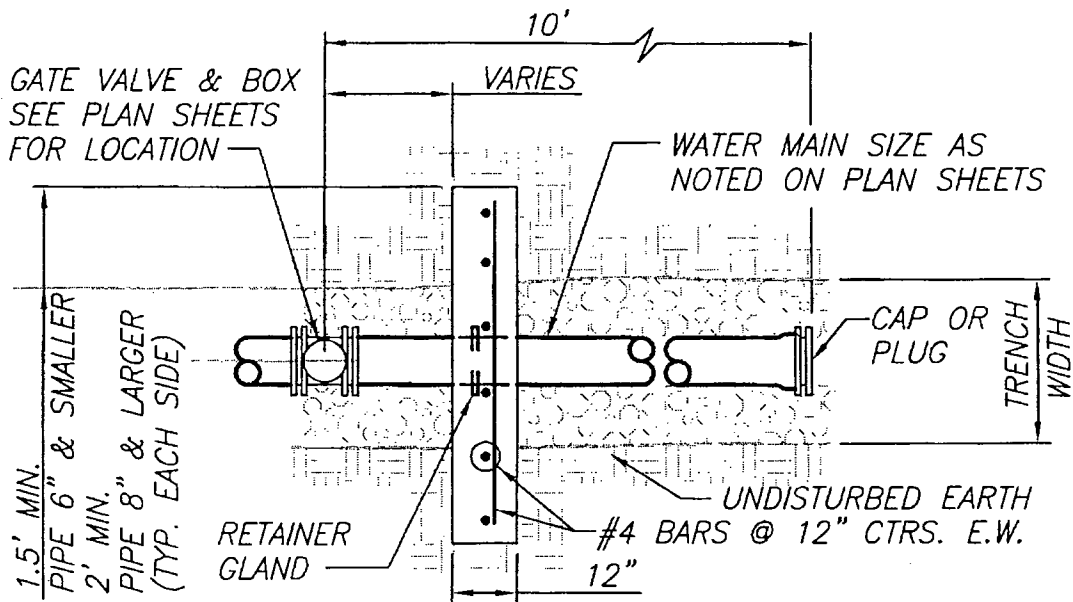
GATE VALVE INSTALLATION

NOT TO SCALE

DETAIL I



ELEVATION

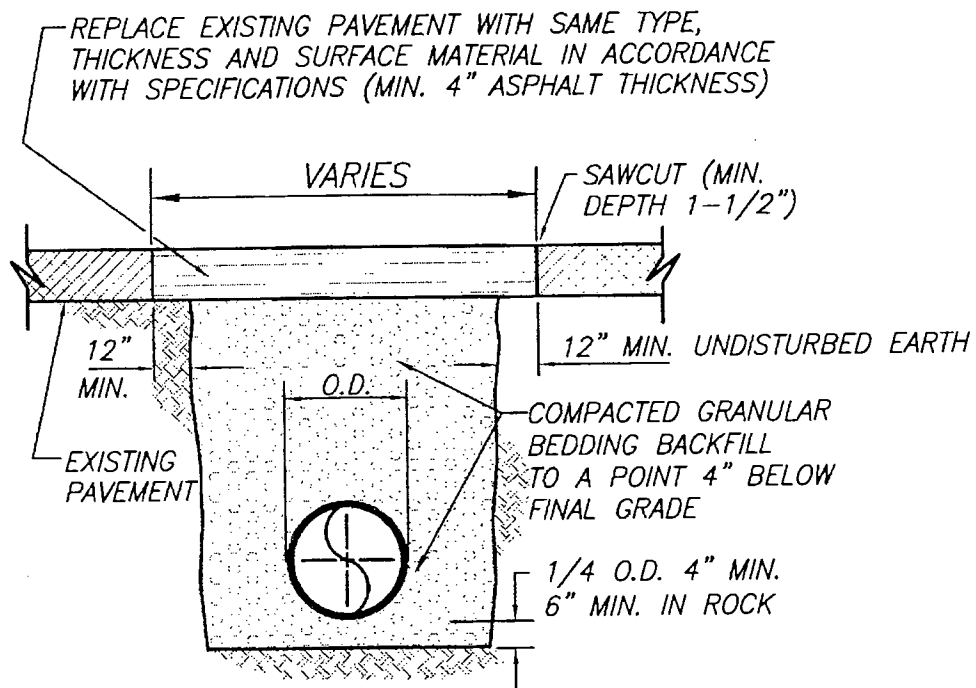


PLAN

LINE TERMINATION DETAIL

NOT TO SCALE

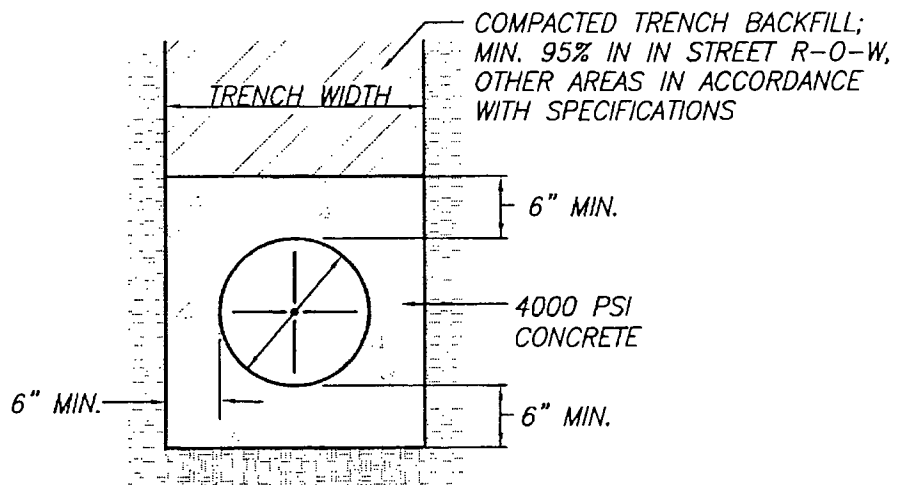
DETAIL J



SAW CUT SHALL BE CONTINUOUS WITH SMOOTH, TAPERED TRANSITIONS IN WIDTH IN ORDER TO MAINTAIN A CONSISTENT PAVEMENT RESTORATION WIDTH.

DRIVEWAY CROSSING
RESTORATION DETAIL
 NOT TO SCALE

DETAIL K



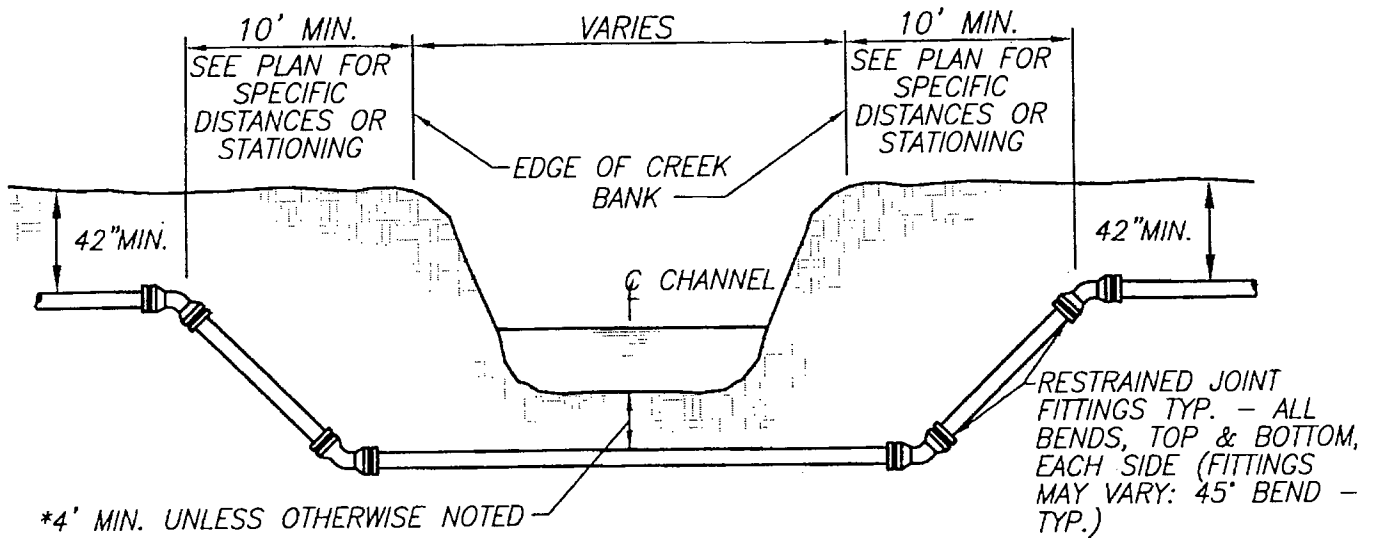
NOTES:

1. BLOCK UP PIPE TO PROVIDE MINIMUM CLEARANCE INDICATED.
2. CONTRACTOR SHALL INSTALL TIE DOWNS TO PREVENT FLOATING.

CONCRETE ENCASEMENT DETAIL

NOT TO SCALE

DETAIL L



*IF 4' MIN. IS NOT MAINTAINED BETWEEN THE PIPE AND CREEK, PIPE MUST BE ENCASED IN CONCRETE FROM 10' EACH SIDE OF CREEK BANK.

CREEK CROSSING DETAIL

NOT TO SCALE

DETAIL M

