



**STANDARD CONTRACT DOCUMENTS  
AND  
TECHNICAL SPECIFICATIONS  
FOR  
UTILITY AND STREET CONSTRUCTION**

**September 2019**

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FOR UTILITY AND STREET CONSTRUCTION

CITY OF RAYMORE, MISSOURI

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# Water Main Specifications

## 1.00 GENERAL DESIGN CRITERIA

### 1.01 General

The design criteria presented in this Article are the minimum standards to be followed in the design and construction of the water distribution systems within Raymore. These minimum standards are not intended to be used as a substitute for actual construction specifications and design computations.

### 1.02 Capacity

The water distribution system and any extension thereof shall have adequate capacity to:

1. Supply the peak hour demands (estimated at 0.67 GPM/customer) of all customers, domestic, public, commercial and industrial while maintaining a pressure of not less than 35 pounds per square inch at all points of delivery, without reducing the service to any customer below these requirements.
2. For residential fire protection, the system must be capable of delivering not less than 1,000 gallons per minute for two (2) hours for fire protection on the day of maximum customer demand (estimated at 0.44 GPM/customer) with a residual pressure of not less than 20 pounds per square inch to at least one point within 300 feet of each building to be served or proposed to be served by such system and extension for residential.
3. For other than residential fire protection, the system must be capable of providing water in such quantity as to adequately protect life and adjoining properties, as determined by the City of Raymore, consistent with alternative protective measures.

### 1.03 Criteria for Estimating Demand

The latest version of the water model adopted by the City of Raymore shall be used for evaluating the effect of new residential/commercial development on the existing water distribution system.

The following criteria will be used in estimating the average day demand, maximum day demand, and peak hour demand incident to the determination of future water main sizes.

1. Residential population =  $N = \text{number of dwelling units} \times 2.78$  people/dwelling unit.

2. Average daily water demand of residential population in gallons per day (gpd)  $R = N \times 100$  gallons/person.
3. Average daily commercial and industrial water demand in gpd =  $C =$  number of commercial and industrial employees  $\times 100$  gallons/person.  
NOTE: Appropriate additional water demand allowance shall be made for commercial and/or industrial establishments of types having water demands in excess of 100 gpd per employee.
4. Average daily school water demand in gpd =  $S =$  number of staff employees and students  $\times 20$  gallons/person.
5. Average daily water demand (in gpd) =  $A = R + C + S$ .
6. Maximum daily water demand (in gpd) =  $M = A \times 2$ .
7. Peak hours demand (in gpd) =  $P = M \times 2$ .
8. Peak hour demand in gallons per minute (gpm) =  $P$  divided by 1440.

#### 1.04 Main Designations

1. Transmission Mains - Transmission mains are classified as mains transporting water from a water source to a pumping station or reservoir. Transmission mains shall be 12 inches in diameter or larger. Materials shall be ductile iron pipe conforming to the current AWWA specification C151, Class 50 with polywrap. Transmission mains shall not be tapped unless approved by the City Engineer.
2. Major Distribution Mains - Major distribution mains shall be all other mains 12 inches in diameter or greater. Material shall be ductile iron pipe conforming to the current AWWA specification C151, Class 50 with polywrap. Fittings shall conform to the current AWWA specifications C110 and C153, and shall have a pressure rating of not less than that of the pipe. Major distribution mains will only be tapped by minor distribution mains. Connections to major distribution mains shall be made at intervals not less than 1,000 feet.
3. Minor Distribution Mains - Minor distribution mains are classified as water mains 6 inches to 12 inches in diameter. Material shall be ductile iron pipe conforming to the current AWWA specification C151, Class 50. Fittings shall conform to the current AWWA specifications C110 and C153 and shall have a pressure rating of not less than that of the pipe. Four inch water mains are not permitted.

#### 1.05 Grid System

Mains shall be laid on a loop or grid system with mains cross connected not more than 1,000 feet apart. Cross mains to be installed as part of a

subdivision or platted lot shall be eight inches in diameter when required by the City Engineer. The cost of the eight inch main shall be the responsibility of the Contractor/Developer and is not eligible for city upsizing reimbursement over the cost of a six inch diameter main.

#### 1.06 Dead End Water Main

Dead end water mains shall not exceed 700 feet in length. All dead end water mains including those to be extended in the future shall have fire hydrant assemblies installed at the terminus point.

All dead end water mains, which are to be extended in the future, shall be installed to the limits of the platted subdivision such that extensions to the mains to serve adjacent subdivision plats may be connected at the plat boundary and shall be installed with a valve and a temporary fire hydrant. The valve shall be the same size as the main.

All dead end water lines which are not to be extended in the future shall be a minimum diameter of six inches and shall extend to the lot line of the last lot to be served.

#### 1.07 Valves

Valves will be installed as follows; two valves at every tee, three valves at every cross, an in-line valve every 1,100 feet or as directed by the City Engineer.

#### 1.08 Fire Hydrants

In water systems and extensions serving one-family and/or two family residential subdivisions, fire hydrants shall be installed at such locations that there will be at least one fire hydrant within 300 feet hose length to the nearest wall of any building, existing or future. Maximum street length between fire hydrants will not exceed 500 feet. Hydrants on adjacent streets will not be considered in meeting the above requirements.

In commercial, industrial and apartment house areas, fire hydrants shall be provided so that in no case shall more than 300 feet of fire hose be required to reach any point at the base of any exterior building wall from the nearest fire hydrant to supply the stipulated fire flow.

Not more than one fire hydrant shall be located on any six inch dead end main.

## **2.00 MATERIALS**

#### 2.01 Scope

This work shall consist of furnishing materials for, and installing water lines and appurtenances in conformity with the lines and grades shown on the approved plans or as directed by the City Engineer.

## 2.02 Water Mains and Fittings

1. Materials for Water Mains and Fittings shall be the following:
  - a. Ductile Iron Pipe - Ductile iron pipe shall conform to the current AWWA specification C151, Class 50. Joints shall be mechanical or push on type. Fittings shall conform to the current AWWA specifications C110 and C153 and shall have a pressure rating of not less than that of the pipe. All transmission mains shall be polyethylene encased in accordance with the current AWWA specification C105. Minimum thickness shall be eight mils.
  - b. Prestressed Concrete Pressure Pipe, Steel Cylinder Type Prestressed concrete pressure pipe, fittings and appurtenances shall conform to the requirements of the current AWWA specification C301. Minimum thickness of the steel cylinder shall be 16 gauge. Gaskets shall be synthetic rubber.

## 2.03 Valves and Appurtenances

### 1. Butterfly Valve

- a. Butterfly valves shall be used in all mains 24 inches or larger. Butterfly valves shall be rubber seated, designed to provide a tight shut off and conform to current AWWA specification C504. Valve disc shall seat 90 degrees with the pipe axis. Shaft seals shall be O-ring type. Direction to open shall be counterclockwise and be marked as such.
- b. Valve shafts and seat surfaces shall be constructed of 18-B Type 304 or Type 316 stainless steel.
- c. Valves shall be Mueller, Clow, M & H, Kennedy, Pratt or approved equal.

### 2. Gate Valves

- a. Valves shall be resilient wedge types rated for 250 p.s.i. cold water working pressure. Valve performance shall meet or exceed the requirements of ANSI/AWWA C515. Valves shall meet the requirements of Underwriters Laboratories Standard 262.
- b. Valve wall thickness shall exceed AWWA C515 and AWWA C153.
- c. Valve body, bonnet, seal plate, and wedge casting shall be constructed of ductile iron in accordance with ASTM A536. The wedge casting shall

be 100% encapsulated with nitrile rubber. No epoxy coating is allowed in wedge. This rubber shall be permanently bonded to the ductile iron wedge casting and shall meet ASTM D429 tests for rubber to metal bonding.

- d. The stem and stem nut shall be made from high strength manganese bronze, UNS alloy C86700. Thrust washers shall be located above and below the thrust collar of the stem. The direction of opening for the valve shall be Left (OL).
- e. The body, bonnet, and seal plate shall be epoxy coated in accordance with ANSI/NSF 61
- f. All Fasteners shall be stainless steel.
- g. Valves shall have laying lengths and clear waterway openings for mechanical joint valves as listed below:

Valve Size	Laying Length	Waterway Diameter
2"	3 1/2"	2 3/16"
3"	4 3/4"	3 3/16"
4"	4 5/16"	4 3/16"
6"	4"	6 3/16"
8"	5 1/4"	8 3/16"
10"	6 7/8"	10 3/16"
12"	8"	12 3/16"
16"	14 1/2"	16 3/16"
20"	11"	20 3/16"
24"	16"	24 3/16"

- 3. Valves shall be EJ, Mueller, Clow, Waterous, American Flow Control, (AFC), M & H, Kennedy, Pratt or approved equal.
- 4. Valve Coating.
  - a. All ferrous metal surfaces of valves and accessories, both interior and exterior, shall be shop-painted with two coats epoxy conforming to current AWWA specification C550.
- 5. Valve Boxes

- a. All buried valves shall be provided with ferrous metal riser and cover. Covers shall have the word "water" cast on it and painted blue.

## 6. Painted Parts

- a. All parts shall be painted with an asphalt varnish in accordance with current AWWA specification C500.

## 2.04 Fire Hydrants

1. All hydrants shall be the traffic model, break-away and conform to the latest revisions of AWWA Standard C502. Fire hydrants shall be rated for 250 psi working pressure and be listed by Underwriters Laboratories Inc. (UL 246) and meet the test requirements of Factory Mutual (FM 1510) at this pressure.
2. Hydrants shall be of a true compression type, opening against the pressure and closing with the pressure. Composition of the main valve shall be a molded rubber having a durometer hardness of 91 +/- 5. The rubber seat valve shall fit a 5 1/4" opening and not be less than 1" thick.
3. Fire hydrants shall be Three-way in design, having (1) 4-1/2" NST Pumper nozzle, and (2) 2 1/2" Nat Std 2 7/8" Base, C Dome hose nozzle. Nozzles shall "thread" counterclockwise into hydrant barrel utilizing "o" ring pressure seals. A suitable nozzle lock shall be in place to prevent inadvertent nozzle removal. Wedging devices and/or ductile iron retainer rings to secure nozzles shall not be allowed.
4. The lubrication system shall be sealed from the waterway and any external contaminants by use of "o" ring pressure seals. Anti-friction washers shall be in place above and below the thrust collar of the operating nut to further minimize operating torque. The grease reservoir shall be factory filled with an FDA approved food grade lubricant. Oil shall not be used.
5. The operating nut shall be a one piece design, manufactured of ASTM B-584 bronze. It shall be 1 1/2" Pentagon- point to flat in size/shape. The operating nut shall be affixed to the bonnet by means of an ASTM B-584 bronze hold down nut. The hold down nut shall be threaded into the bonnet in such a manner as to prevent accidental disengagement during the opening cycle of the hydrant. A resilient weather seal shall be incorporated with the hold down nut, for the purpose of protecting the operating mechanism from the elements.



6. The direction of opening shall be Left. An arrow shall be cast on the top of the hydrant to indicate the opening direction.
7. The hydrant bonnet shall be attached to the upper barrel by no more than six bolts and nuts. All nuts and bolts below grade shall be 304 stainless steel.
8. The hydrant will have 5'0" Depth of bury, unless otherwise noted.
9. Hydrants shall be of the "Traffic Model" design, provided with a safety coupling and flange design that will permit a full 360 degree facing of the nozzles. The safety coupling shall be a one piece design. Multiple part or cast iron coupling designs are not allowed.
10. The operating stem shall be a two piece design, not less than 1 ¼ " diameter (excluding threaded or machined areas). Threads shall be Acme type with no 60 deg. V threads allowed. Travel stops shall be in the inlet/shoe and are not allowed in the bonnet area. Screws, pins, bolts or fasteners used in conjunction with the stem coupling shall be stainless steel.
11. The inside diameter of the hydrant barrels shall not be less than 7 inches and the hydrant shall be painted Yellow.
12. Heavy duty drip shutoff (top plate) and valve seat shall be high strength manganese bronze. Valve seat shall be installed in a bronze seat ring. Drains shall be bronze lined and 3/8 inch diameter minimum. They shall operate without the use of springs, toggles, tubes, levers or other intricate synchronizing mechanisms. Lower valve plate shall be a one piece ductile iron casting and not require a separate cap nut. Drains shall be open and flushed during the first 4 turns of opening the hydrant before positively closing while operating the hydrant.
13. The shoe connection shall be Mechanical Joint or as specified. The inlet/shoe shall be fusion bonded epoxy coated per ANSI/AWWA C550 and with an NSF61 approved coating having ample blocking pads for sturdy setting. Six stainless steel bolts and nuts are required to fasten the shoe to the lower barrel. The shoe/inlet shall be directly connected to the standpipe flange. Designs using a sandwich piece in between the standpipe and shoe/inlet shall not be allowed.

14. External parts- the top bonnet, upper standpipe, lower standpipe and shoe shall be ductile iron to ensure strength throughout the exterior of the hydrant- Gray Iron hydrant body parts will not be allowed.
15. Hydrants shall be manufactured optic yellow. Field painting is not allowed.
16. Hydrants shall be furnished with a black plastic caps or shall be covered with a black plastic bag until the hydrant is available for service.

Upon request, supplier shall furnish flow data indicating friction loss in psi at a flow of 1,000 gpm from the pumper nozzle. Such friction loss shall not exceed 2.5 psi. All cast components shall be made in the USA and Comply with EPA (AIS) requirements of Section 436.

Approved hydrants are the EJ WaterMaster 5CD250 or approved equal.

#### 2.05 Tapping Sleeves and Valves

Tapping sleeves and valves, when connecting to existing live mains or where required by the approved Engineering drawings, shall be 200 psi, resilient-seated, cast iron body, non-rising stem gate valves conforming with all applicable requirements of the current AWWA specification C509. Direction to open shall be counterclockwise and be marked as such.

Tapping sleeves shall be stainless steel and compatible with the tapping valve.

Tapping sleeves and valves shall be Mueller, Clow, Waterous, American Flow Control (AFC), M & H, Kennedy or approved equal.

### **3.00 INSTALLATION**

#### 3.01 Pipe, Hydrants, Valves, and Tapping Sleeves

1. Ductile Iron Pipe - Ductile iron pipe shall be installed in accordance with the current AWWA specification C600. All joints, fittings and other appurtenances, shall be laid at least 18 inches from any obstruction, fire hydrants shall be 36 inches from any obstruction. Fire hydrants shall be installed where shown on the Engineering Drawings and in accordance with Standard Detail Wtr-1.
2. Prestressed Concrete Pipe - Prestressed concrete pipe shall be installed in accordance with the current AWWA specification M9.

#### 3.02 Traffic Control

Traffic Control devices shall be provided by the Contractor/Developer in accordance with the current MUTCD to regulate, warn and guide traffic at the work site.

### 3.03 Pipe Alignment and Grades

All pipe shall be laid and maintained to the required lines and grades, with hydrants, valves and fittings at the required locations and with joints centered and drawn "home", and with all valve and hydrant stems plumb. The developer/contractor shall furnish line and grade stakes necessary for the work. It shall be the Contractor's responsibility to preserve these stakes from loss or displacement. The Engineer may order and replace any stakes he deems necessary for the proper prosecution of the work. Any replacements shall be at the Contractor's expense. All pipes shall be laid to the depth shown on the contract drawings and/or cut sheets as supplied by the Engineer. The Contractor shall satisfactorily maintain the specified cover by a means approved by the Engineer. If additional bends are required where not shown on the drawings to maintain alignment around curves, the Contractor shall provide the required number and be compensated at the unit price as proposed on the bid form. The following is the maximum allowable joint deflection for the ductile iron pipe:

AWWA C-600 TABLE 1 and 2 SUMMARY (20' pipe length – except as noted.)		
Pipe Size	Mechanical Joint	Push on Joint
6"	27"*	21"
8"	20"*	21"
12"	22"	21"
16"	15"	12"
18"	12"	12"
20"	12"	12"
24"	10"	12"
30"	10"	8"
36"	9"	8"
42"	8"	8"
48"	8"	8"

Note: \* 18' Length

### 3.04 Thrust Restraints

All plugs, caps, tees, bends and hydrants shall be provided with thrust blocks in accordance with Standard Detail Wtr-2 and Wtr-3. Concrete thrust blocks shall have a minimum 28-day compressive strength of 4000 psi. Concrete shall be placed and cured for 24 hours prior to energizing the water line.

Concrete shall extend from fitting to undisturbed soil and shall be installed so that all joints are accessible. If adequate soil support cannot be obtained, a mechanical restraining assembly shall be installed as approved by the City Engineer.

### 3.05 Handling and Storage

All pipe, fittings, valves, hydrants and accessories shall be loaded, unloaded, stored and installed in such a manner to prevent structural damage or coating damage. Any damaged materials shall be replaced or restored to its original condition at the Contractor/Developer's expense.

### 3.06 Cleaning

All pipe, fittings, valves, hydrants and accessories shall be kept clean of foreign matter while being handled or stored. During installation, foreign matter shall not enter the pipe or appurtenances. At the end of each working day, a temporary plug shall be installed at the termination of the water line.

### 3.07 Inspection

A Public Works Inspector will inspect all pipe, fittings, valves, hydrants and accessories for damage or defect prior to installation. Damaged or defective materials shall be replaced or restored to its original condition by the Contractor/Developer.

### 3.08 Connection to Existing Main

The Contractor/Developer shall furnish and install all of the fittings necessary for connections between new water mains and existing water mains. Tapping sleeves and valves are required when connecting to existing live mains or where required by approved engineering drawings. The installation of tapping sleeves and valves shall be done while a Public Works Inspector is present.

Tapping into existing mains shall be done with no interruption of existing services unless otherwise approved by the City Engineer 48 hours prior to disruption of service. Valves on the existing water system or valves that separate newly constructed mains from the existing water system shall be operated by the Public Works Inspector.

Special care should be taken when making a connection to an existing main. No foreign material or contaminants will be permitted to enter the water system.

Thrust blocks shall be provided at the new connection to provide thrust restraint in accordance with Standard Detail Wtr-2 and Wtr-3.

### 3.09 Service Connections

The City will install a corporation connection at the main for individual, commercial, industrial and residential service lines up to one (1) inch in

diameter. The Contractor/Developer shall notify the Building Inspections Department 48 hours in advance of requiring a service connection. Any tap greater than one (1) inch is the Contractor's responsibility.

Excavation for service connections shall be provided by the Contractor/Developer. Installation of meters greater than two inch diameter will be specifically approved by the City Engineer. Excavation shall be backfilled within 24 hours.

### 3.10 Water Lines In Relation To Sewers – Separation of Water Mains, Sanitary Sewers and Storm Sewers

#### 1. Adequate Separation Factors - 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 connections,
- e. space for repair and alterations of water and sewer pipes,
- f. off-setting of pipes around manholes and other sewer structures.

#### 2. Parallel Installation

Water mains shall be laid at least ten feet horizontally from any existing or proposed sanitary sewer and storm sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain this separation, the City Engineer 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 in either case, at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.

#### 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, a full length of water pipe shall be located such that both joints will be as far from the sewer as possible. Special structural support (i.e. encasement) for the water and sewer pipes may be required.

4. Force Mains  
There shall be at least a ten-foot horizontal separation between water mains and sanitary sewer force mains. There shall be an 18-inch vertical separation at crossings as required in Item 3.
5. Sewer Manholes and Other Structures  
No water line shall be located closer than ten feet to any part of a sanitary sewer manhole or storm sewer curb inlet, junction box, or other storm sewer structure.
6. Exceptions  
The City Engineer may approve on a specific case by case basis deviations from the above requirements when the City Engineer has determined it is impossible to obtain the specified separation distance.

#### 3.11 Straddle Blocks

Straddle blocks shall be provided every 50 feet for water mains which exceed ten percent slope and for the end of dead end water mains as shown on Standard Detail Wtr-4. Concrete shall be placed and cured for 24 hours prior to energizing the water line.

#### 3.12 Polyethylene Encasement

Polyethylene encasement shall be installed in accordance with the current AWWA specification C105 and Standard Detail Wtr-5.

#### 3.13 Stream Crossings Water mains at stream crossings shall be encased as per Standard Detail San-6.

### **4.00 DISINFECTION**

Precautions, methods, procedures and materials for disinfection shall conform to current AWWA specification C651.

Precaution shall be taken to protect the interior of pipes, fittings and valves against contamination. Pipe shall be handled in such a manner to prevent the entrance of foreign material or water. Not more than 4,000 feet of water main shall be installed without disinfecting.

The Public Works Inspector shall be notified by the contractor/Developer 24 hours prior to commencing disinfection. The disinfection shall proceed as follows:

#### 4.01 Filling

After installation, the entire main shall be completely filled to eliminate air and be flushed to remove any material that may have entered the main.

#### 4.02 Chlorination

Chlorination by the Contractor/Developer shall be the "continuous-feed method" or the "slug-method" as outlined in the current AWWA specification C651, or a method as approved by the City Engineer.

#### 4.03 Operation

Prior to flushing the line free of chlorine, the Contractor/Developer shall operate all valves and hydrants in order to disinfect appurtenances. Contractor shall use extreme care so as to avoid any chlorine spikes in the existing system.

#### 4.04 Final Flushing

Final flushing shall begin after the appropriate retention period has elapsed and the chlorine residual in the line meets regulatory requirements. The chlorinated water shall be flushed from the main until chlorine measurements show the water leaving the test main are no higher than that prevailing the system.

Test water flushed from the water main shall be disposed of in an environmentally safe manner. Discharge of test water into sanitary sewers will not be permitted. After the chlorinated water has been flushed out of the line, bacteriological test samples shall be taken by the Public Works Inspector and submitted to the Kansas City Water Department, or other laboratory at the City's discretion, to ensure the absence of coliform organisms. Test results shall be submitted to MDNR for evaluation.

If initial disinfection fails to produce satisfactory chlorine residual and bacteriological samples, the disinfection shall be repeated at the expense of the Contractor/Developer until satisfactory samples can be obtained.

### **5.00 HYDROSTATIC TESTING**

Hydrostatic pressure and leakage testing shall be performed by the Contractor/Developer in the presence of the Public Works Inspector in accordance with current AWWA specification C600 procedures. The Contractor/Developer shall supply all pipe, tools and equipment necessary to operate the test.

The hydrostatic pressure during testing shall be at least 150 psi. Duration of the test shall be at least two hours.

The leakage test shall be conducted concurrently with the pressure test. The pipeline is acceptable if the leakage does not exceed the allowable limits as determined by the following formula:

$$Q = LD (P)^{1/2} / 133,200$$

WHERE: Q = Allowable leakage, in gallons per hour

L = Length of pipe tested, in feet

D = Nominal Diameter of pipe, in inches

P = Average test Pressure during leakage test in psi

Water lines which fail to meet the test standards shall be repaired and retested, at the expense of the Contractor/Developer, as necessary, until the test requirements are met. Not more than 4,000 feet of main shall be installed without testing.

## **6.00 EXCAVATION, TRENCHING AND BACKFILLING**

### 6.01 General

The trench shall be so dug that the pipe can be laid to the alignment and depth required and shall be excavated only so far in advance of pipe laying as the Engineer shall specify. The trench shall be so braced and drained that the workmen may work therein safely and efficiently. All trenches shall be sheeted and braced to a safe angle of repose. Such angle of repose shall be no less than that repose required by the requirements of the Occupational Safety and Health Act (OSHA), whichever is more restrictive.

### 6.02 Trench Width and Description

The trench width, at the top of the trench may vary depending on the depth of the excavation and the nature of excavated material encountered. However, the maximum allowable width of trench shall be in strict accordance with Section 2902.1 APWA specifications. The width of the trench shall also be kept at a minimum to prevent excess destruction of the existing ground surface. The trench width at pipe grade shall be ample to permit the proper laying and jointing of the pipe and fittings and for proper backfilling and compaction. The maximum clear width of trench at the top of the pipe shall be not greater than the outside diameter of the pipe plus 2 feet.

All trenches shall be excavated so that the pipe may be laid accurately to grade with a minimum of 42 inches of earth cover over the top of the water mains, unless otherwise noted on the drawings and/or cut sheets. The trench shall have a bottom conforming to the grade to which the pipe is to be laid. The pipe shall be laid upon sound soil, cut true and even so that the barrel of the pipe will have a bearing for its full length. If the excavation is inadvertently made below the bottom conforming to grade, it shall be backfilled with well tamped pit run sand or fine gravel or other material as approved by the Engineer at no additional expense to the owner.

Bell holes shall be dug at the ends of each length of pipe to permit proper jointing. Excavations for manholes and other structures shall have a one foot minimum clearance on all sides. The trench shall be kept free from water until the joints have been completed.

### 6.03 Pipe Foundation in Poor Soil



When the bottom at subgrade is soft and in the opinion of the Engineer cannot adequately support the pipe, a further depth and/or width shall be excavated and refilled to pipe foundation grade with material approved by the Engineer and thoroughly compacted; or other approved means, such as piling, shall be adopted to assure a firm foundation for the pipe with extra compensation allowed, the Contractor as provided elsewhere in these specifications. This provision only applies in those instances/locations when normal dewatering operations are not viable and/or poor soil conditions exist as determined by the Engineer.

The Contractor shall furnish, drive and place piling if ordered by the Engineer. Piles shall be driven in exact position at locations determined by the Engineer. The Contractor, at his own expense, must replace piles not correctly positioned at the completion of driving.

#### 6.04 Pipe Clearance in Rock

Large rock boulders and large stones shall be removed to provide a clearance of at least 12 inches below outside barrel of the pipe, valves or fittings and to a clear width of 12 inches on each side of all pipe and appurtenances for pipe 16 inches or less in diameter; for pipes larger than 16 inches, a clearance of 18 inches below a clear width of 9 inches on each side of pipe shall be provided. Adequate clearance for properly jointing pipe laid in rock trenches shall be provided at bell holes.

#### 6.05 Pipe Foundation in Rock

The space between the bottom of the trench in rock conditions and the required bedding of the pipe as per Standard Detail Wtr-6 shall be backfilled with granular material approved by the Engineer, thoroughly tamped. No additional compensation for placing or ramping this material shall be allowed.

#### 6.06 Solid Rock Excavation Defined

Solid rock excavation shall include such rocks as are not decomposed, weathered or shattered and which will require extraordinary construction activity as determined by the Engineer including, but not limited to, blasting, barring, wedging or use of air tools for removal.

Under this classification shall be included the removal of any concrete or masonry structure (except concrete pavement, curb, gutter and sidewalk) exceeding one (1) cubic yard in volume that may be encountered in the work.

#### 6.07 Blasting Procedure

The hours of blasting will be fixed by the Engineer. The Contractor's method of procedure relative to blasting shall conform to local and state laws and Municipal Ordinances.

#### 6.08 Braced and Sheeted Trenches

The Contractor shall adequately brace and sheet excavations wherever necessary to prevent caving or damage to nearby property. The cost of this temporary sheeting and bracing, unless provided for otherwise, shall be considered as part of the excavation costs without additional compensation to the Contractor. Trench sheeting shall remain in place until pipe has been laid, tested for defects and repaired if necessary and the earth around it compacted to a depth of 1 foot over the top of the pipe. Sheeting, bracing, etc., placed in the "pipe zone" (that part of the trench below a distance of 1 foot above the top of the pipe) shall not be removed without the written permission or written order of the Engineer; that sheeting thereby left in place shall be paid for at the unit price bid. Sheeting ordered left in place by the Engineer in writing shall be paid for at the unit price bid. The Contractor may also leave in place, at his expense, to be embedded in the backfill of the trench, any sheeting or bracing in addition to that ordered left in place by the Engineer for the purpose of preventing injury or damage to persons, corporations or property, whether public or private, for which the Contractor under the terms of this contract is liable.

#### 6.09 Piling of Excavated Material

All excavated material shall be piled in a manner that will not endanger the work or damage property that is to be avoided and also will avoid obstructing sidewalks and driveways. Gutters shall be kept clear or other satisfactory provisions made for street drainage.

#### 6.10 Barricades, Guards and Safety Provisions

At no cost to the Owner, the Contractor shall protect persons from injury and to avoid property damage, shall place and maintain adequate barricades, construction signs, torches, flashers and guards as required in accordance with the contract documents and the Manual on Uniform Traffic Control Devices during the progress of the construction work and until the site is returned to a safe and usable manner. All material piles, trenches, excavations, equipment and pipe which may serve as hazards to the public shall be enclosed by fences or barricades and shall be protected by proper lights when the visibility is poor. The rules and regulations of the local and state authorities respecting safety provisions shall be observed.

#### 6.11 Private Property Protection

The Contractor shall be responsible for, but not limited to, the protection of trees, fences, poles and all other private property unless their removal is authorized by the Engineer. Property damage shall be satisfactorily restored by the Contractor or adequate compensation therefore shall be the responsibility of the Contractor at no additional cost to the Owner.

#### 6.12 Jack Steel Casing Pipe in Place

Steel casing pipe shall be jacked in place to provide a conduit for the carrier pipe.

The carrier pipe shall be installed within the casing pipe using high density polyethylene spacers or similar devices to center the carrier pipe within the casing pipe. Upon completion of the carrier pipe installation, watertight removable end seals shall be installed for the casing conduit. Cathodic and corrosion protection are required depending on the carrier/casing pipe used. Typical detail per Standard Detail St-13.

Jacking shall be paid for at the contract unit price bid per lineal foot installed and shall include the casing pipe, jacking pits, cathodic and corrosion protection, watertight seal, dewatering and all other labor and materials necessary to complete the work.

The existing casings shall be cut or trimmed as shown on the plans. All labor and materials necessary to complete the work shall be considered incidental to the installation of the carrier pipe.

#### 6.13 Backfill

Backfill under pavements, driveways, sidewalks, and other paved areas:

1. Flowable fill shall be used for backfill under all paved areas. Flowable fill mix design must be approved by the Engineer prior to placement. Backfill shall be placed as shown on Standard Detail St-11 (APWA p26-14)

Backfill in areas other than paved areas:

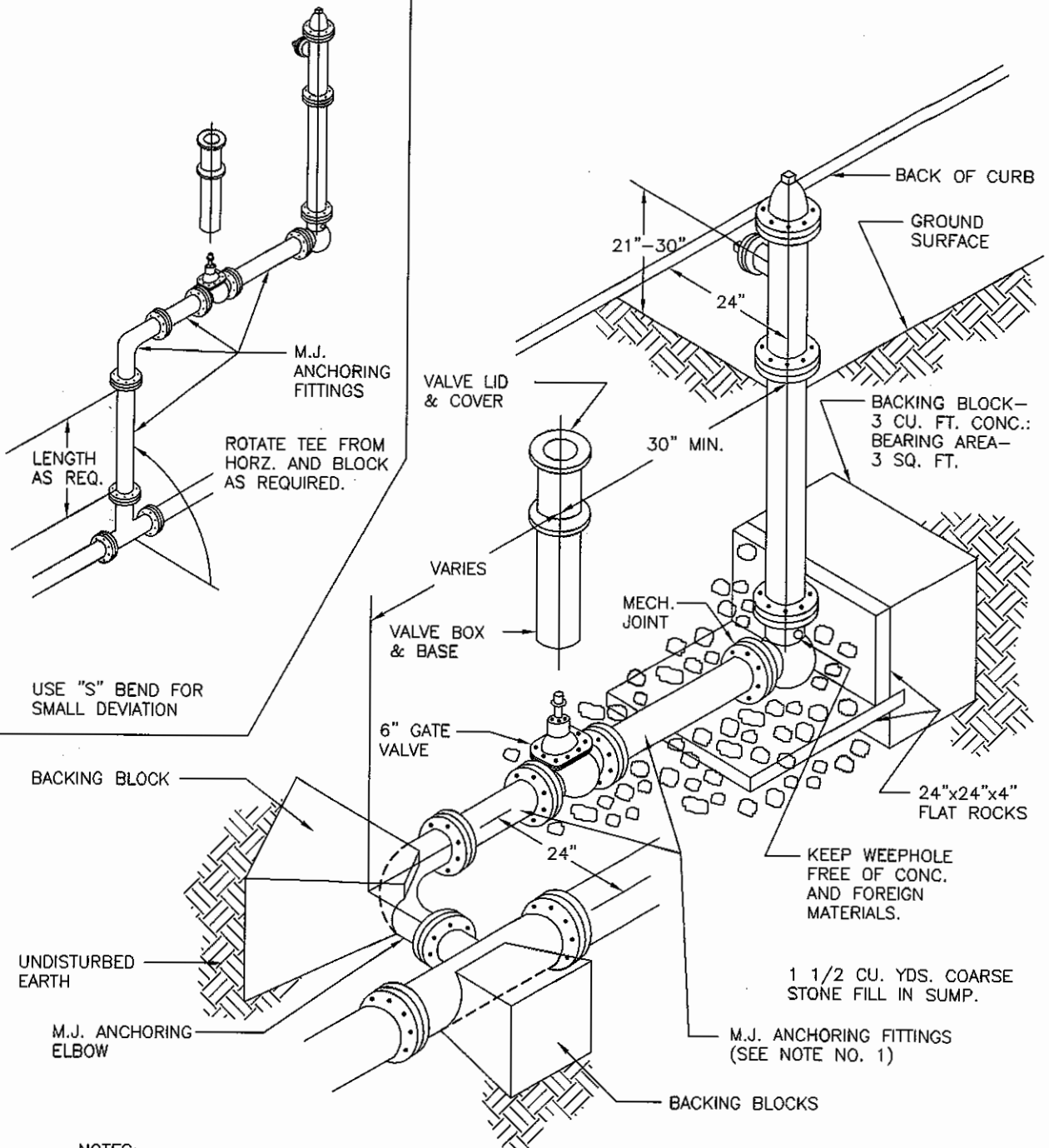
1. Backfill shall be finely divided, excavated material, free from debris, organic material, frozen material, and stones larger than six inches.

### **7.00 WATER MAINS NOT MEETING MINIMUM SPECIFICATIONS**

Water lines not meeting requirements of these construction standards shall be replaced or repaired in a manner approved by the City Engineer. Defective materials shall be completely removed and replaced with acceptable materials.

### **8.00 PROTECTION OF EXISTING FACILITIES**

All construction operations in the vicinity of existing facilities shall be performed with care to prevent damage to these facilities. If damage occurs, repairs shall be made in a manner approved by the City Engineer and any damaged facilities shall be repaired with new materials and restored to its original condition.

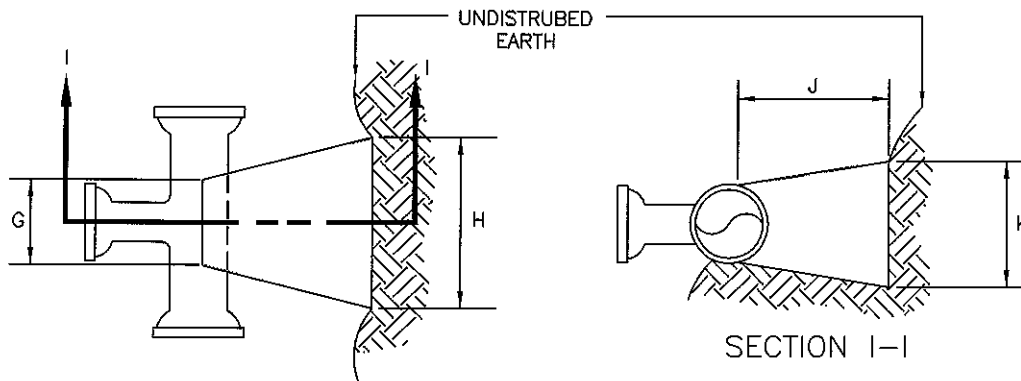


**NOTES:**

1. ALL FIRE HYDRANTS SHALL BE INSTALLED USING MEGALUG STYLE FITTINGS.
2. VALVE BOX AND BASE ARE TO BE DUCTILE IRON.
3. ALL HYDRANTS SHALL BE CLOW MEDALLION, KENNEDY "GUARDIAN" or MUELLER "CENTURION".
4. ALL HYDRANTS SHALL BE DELIVERED PAINTED SAFETY YELLOW. FIELD PAINTING IS NOT ACCEPTABLE.

Engineering Department City of Raymore 100 Municipal Circle Raymore, MO 64083 816-331-1852 Fax 816-331-8067	
DRAWN	Modified 2013
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APPROVED	

<i>CITY OF RAYMORE</i>			
TYPICAL HYDRANT INSTALLATION WITH 90° BEND (TYPE "A")			
SIZE	FSCM NO.	DWG NO.	REV
A		Wtr- 1	
SCALE NONE		SHEET 1 OF 1	



**NOTES:**

1. WHEN USING A PLUG OR TEE WITH A BRANCH SIZE NOT COVERED IN THESE CHARTS, A BACKING BLOCK FOR THE NEXT LARGER PLUG OR BRANCH SHALL BE USED.
2. BACKING BLOCKS FOR PIPING SIZES UP THROUGH 12-INCH ARE BASED ON WORKING PRESSURE OF 225 P.S.I. INCLUDING SURGE.
3. BACKING BLOCKS FOR PIPING SIZES 16-INCH THROUGH 24-INCH ARE BASED ON A WORKING PRESSURE OF 200 P.S.I. INCLUDING SURGE.

BRANCH SIZE	G	H	J	K
6"	8"	30"	24"	18"
8"	8"	40"	24"	24"
12"	12"	54"	30"	40"
16"	12"	65"	36"	50"
20"	16"	85"	40"	60"
24"	18"	102"	54"	72"

CUBIC FEET OF CONCRETE REQUIRED								
PLUG		RUN	TEE					
			BRANCH					
SIZE	CU. FT.		6	8	12	16	20	24
6	5	6	5	-	-	-	-	-
8	8	8	5	8	-	-	-	-
12	21	12	5	8	21	-	-	-
16	37	16	5	8	21	37	-	-
20	64	20	5	8	21	37	64	-
24	123	24	5	8	21	37	64	123

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 City of Raymore  
 100 Municipal Circle  
 Raymore, MO 64083  
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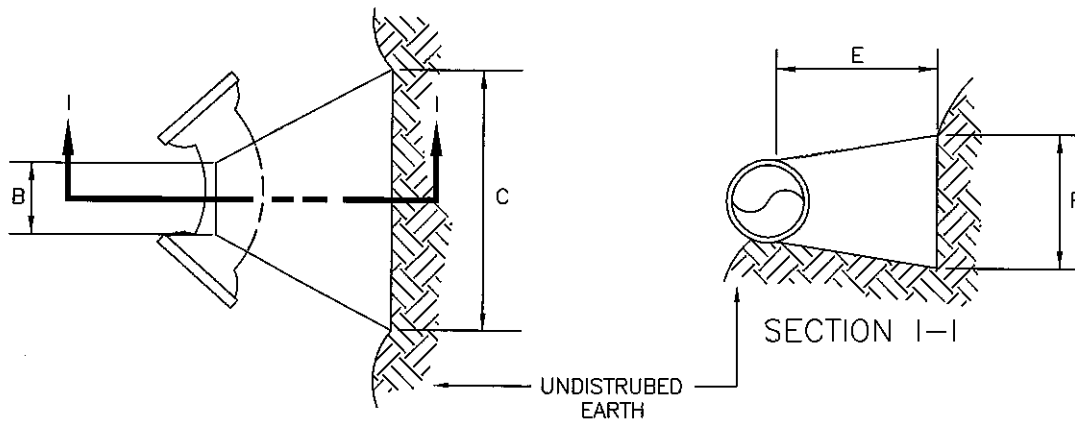
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*CITY OF RAYMORE*

TYPICAL BACKING BLOCKS  
 FOR TEES AND PLUGS

SIZE A	FSCM NO.	DWG NO. Wtr - 2	REV
SCALE NONE		SHEET 1 OF 1	



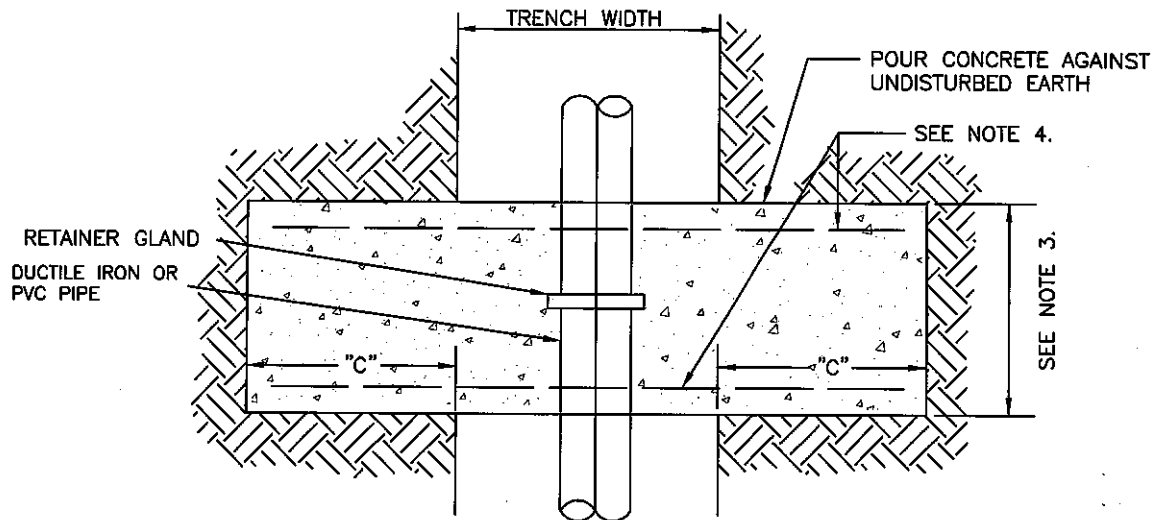
**NOTES:**

1. WHEN USING A BEND WITH A DIAMETER NOT COVERED IN THESE CHARTS, A BACKING BLOCK FOR THE NEXT LARGER DIAMETER PIPE WITH THE SAME DEGREE OF BEND SHALL BE USED.
2. BACKING BLOCKS FOR PIPING SIZES UP THROUGH 12-INCH ARE BASED ON WORKING PRESSURE OF 225 P.S.I. INCLUDING SURGE.
3. BACKING BLOCKS FOR PIPING SIZES 16-INCH THROUGH 24-INCH ARE BASED ON A WORKING PRESSURE OF 200 P.S.I. INCLUDING SURGE.

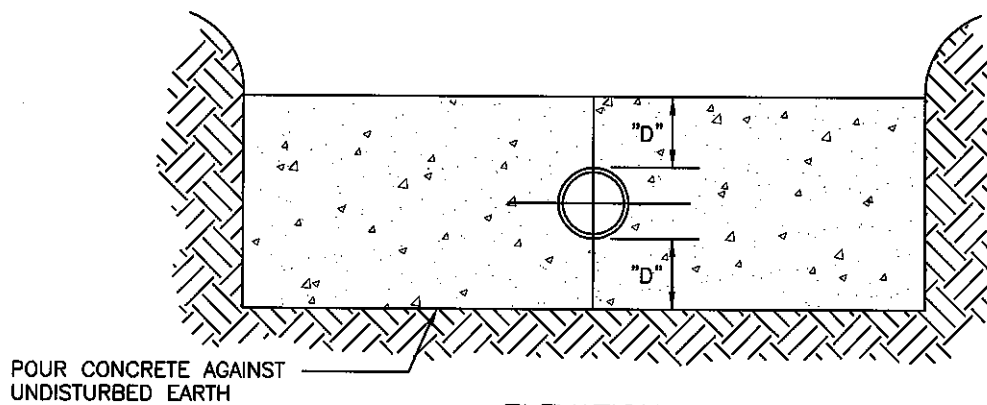
BENDS	B	C	D	E	F
6" 11 1/4° & 22 1/2°	8"	12"	8"	24"	9"
6" 45°	8"	17"	8"	24"	12"
6" 90°	8"	27"	8"	24"	14"
8" 11 1/4° & 22 1/2°	8"	16"	10"	24"	12"
8" 45°	8"	23"	10"	24"	16"
8" 90°	8"	34"	10"	24"	20"
12" 11 1/4° & 22 1/2°	8"	26"	12"	24"	16"
12" 45°	8"	34"	12"	24"	24"
12" 90°	8"	50"	12"	24"	30"
16" 11 1/4°	8"	20"	16"	24"	16"
16" 22 1/2°	8"	32"	16"	24"	20"
16" 45°	8"	42"	16"	30"	30"
16" 90°	8"	58"	16"	36"	40"
20" 11 1/4°	12"	24"	20"	24"	20"
20" 22 1/2°	12"	42"	20"	30"	24"
20" 45°	12"	54"	20"	36"	36"
20" 90°	12"	75"	20"	42"	48"
24" 11 1/4°	12"	30"	24"	24"	24"
24" 22 1/2°	12"	44"	24"	30"	33"
24" 45°	12"	59"	24"	42"	48"
24" 90°	12"	87"	24"	54"	60"

CUBIC FEET OF CONCRETE REQUIRED				
BEND	11 1/4°	22 1/2°	45°	90°
6"	1.4	1.4	2.9	3.3
8"	2.1	2.1	3.3	5.5
12"	3.8	3.8	6.5	11.3
16"	3.8	5.6	12.4	25.9
20"	5.4	11.2	23.2	47.2
24"	7.4	15.5	38.4	86.6

<b>PLANNING &amp; ENGINEERING</b> 100 MUNICIPAL CIRCLE RAYMORE, MO 64083 (816)331-0488 FAX (816)331-8067		<h1 style="margin: 0;">CITY OF RAYMORE</h1> <h2 style="margin: 0;">TYPICAL BACKING BLOCKS FOR BENDS</h2>			
DRAWN	Modified 2013	DATE			
CHECKED		SIZE	FSCM NO.	DWG NO.	REV
APPROVED		A		Wtr - 3	
			SCALE	SHEET 1 OF 1	
			NONE		



PLAN



ELEVATION

PIPE SIZE	"D" MIN.	CU. FT.	"C"
2"	4"	12	24
6"	4"	18	24
8"	7"	30	24
12"	15"	61	24
16"	18"	-	30
20"	20"	-	42
24"	24"	-	48

NOTES:

1. FOR 2 THROUGH 12 INCH PIPE, STRADDLE BLOCKS ARE SIZED FOR 225 P.S.I. LINE PRESSURE INCLUDING SURGE.
2. FOR 16 THROUGH 24 INCH PIPE, STRADDLE BLOCKS ARE SIZED FOR 200 P.S.I. LINE PRESSURE INCLUDING SURGE.
3. FOR 2 THROUGH 12 INCH PIPE, 24 INCH MINIMUM OR EQUAL TO TRENCH WIDTH.  
FOR 16 THROUGH 24 INCH PIPE, 18 INCH MINIMUM OR EQUAL TO TRENCH WIDTH.
4. #5 BARS AT 12" CENTERS IN EACH DIRECTION FOR 16 THROUGH 24 INCH PIPES.
5. CONCRETE SHALL HAVE A MINIMUM STRENGTH OF 4000 PSI.

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 Raymore, MO 64083  
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DRAWN  
 Modified 2013

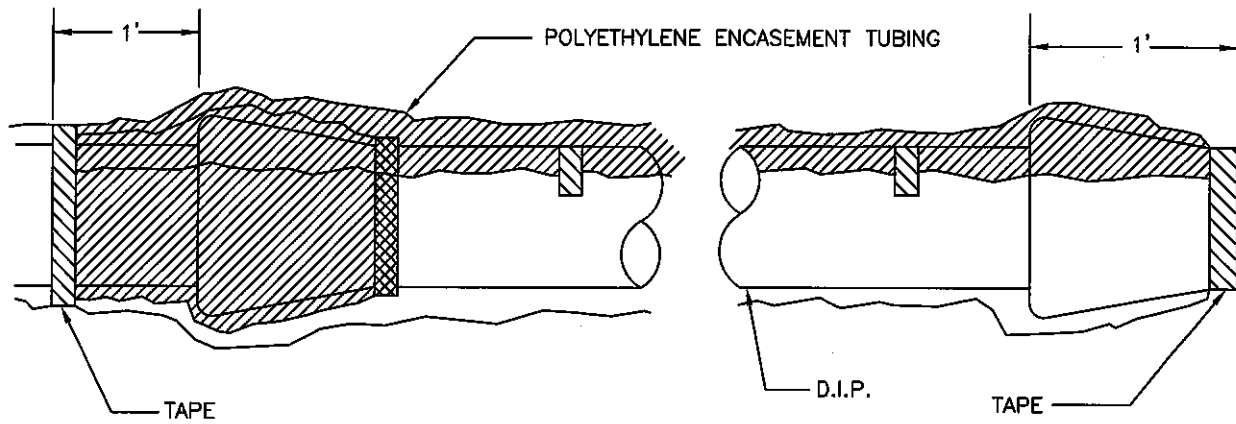
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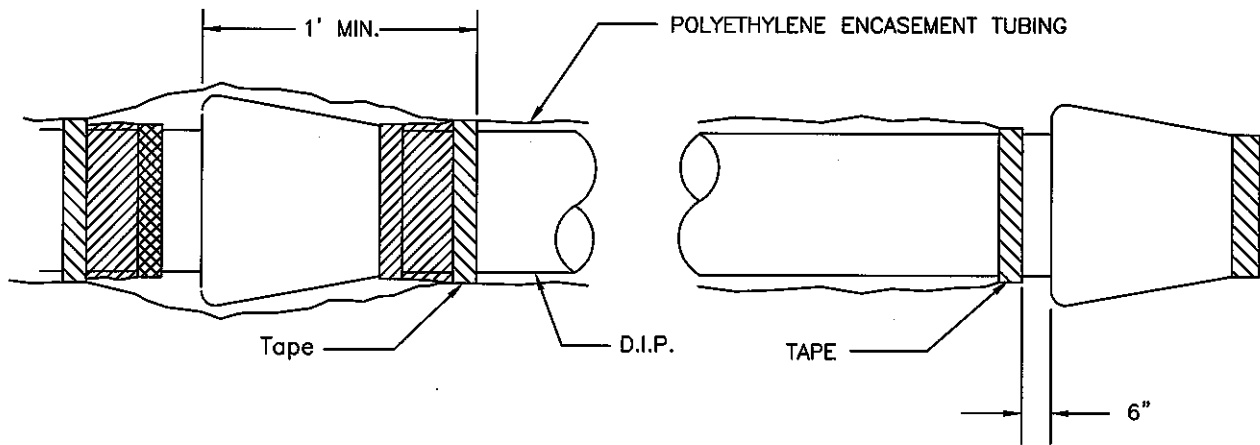
*CITY OF RAYMORE*

TYPICAL STRADDLE BLOCK

SIZE A	FSCM NO.	DWG NO. Wtr - 4	REV
SCALE NONE	SHEET 1 OF 1		



METHOD A

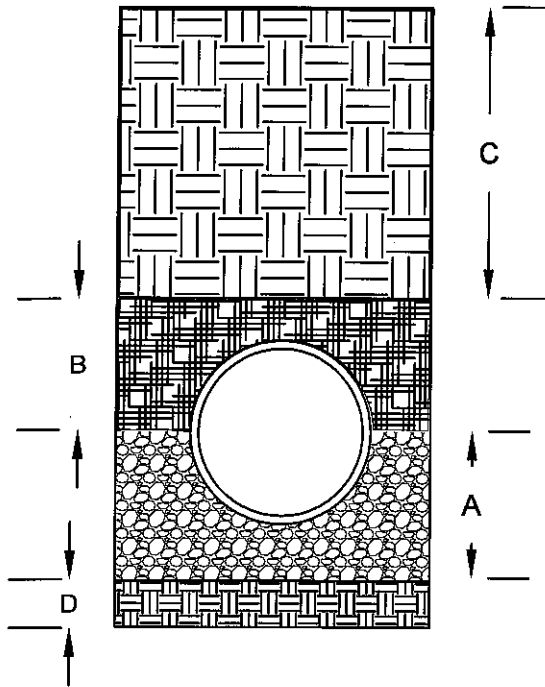


METHOD B

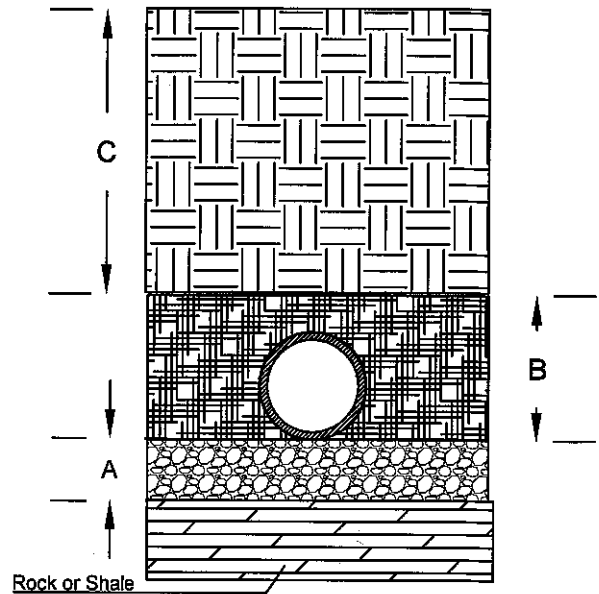
NOTES:  
Polywrap shall be installed on all ductile iron pipes 12" and larger.

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DRAWN Modified 2013		POLYETHYLENE ENCASEMENT FOR DUCTILE IRON PIPE		
CHECKED	DATE	SIZE A	FSCM NO.	DWG NO. Wtr - 5
APPROVED		SCALE NONE		REV
			SHEET 1	OF 1





Embedment for Pipe 24" and Larger



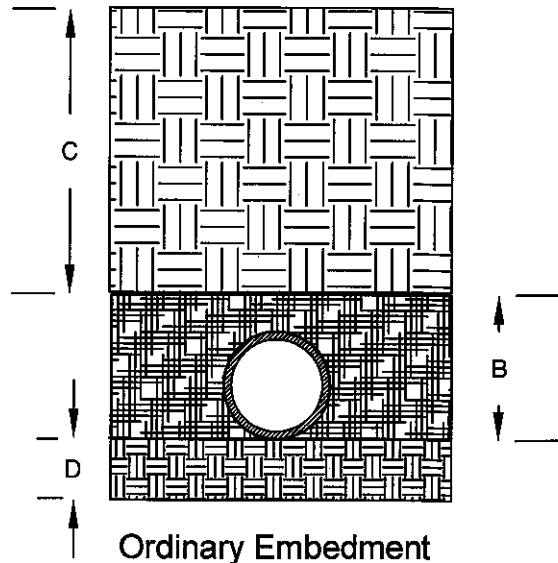
Embedment for Pipe in Rock or Shale

**Legend**

- "A" - 3/8" to 1/2" clean gravel placed to a minimum depth of 4" below bell.
- "B" - Loosely compacted backfill, free of rock or shale, placed to a depth covering the pipe by 6".
- "C" - Compacted backfill.
- "D" - Undisturbed earth

**Notes:**

1. Ductile iron pipe 12" in diameter and larger shall be polywrapped and taped as per spec.
2. Rock and shale shall be over-excavated to a depth where gravel can be placed to a depth of 4" below the bell.



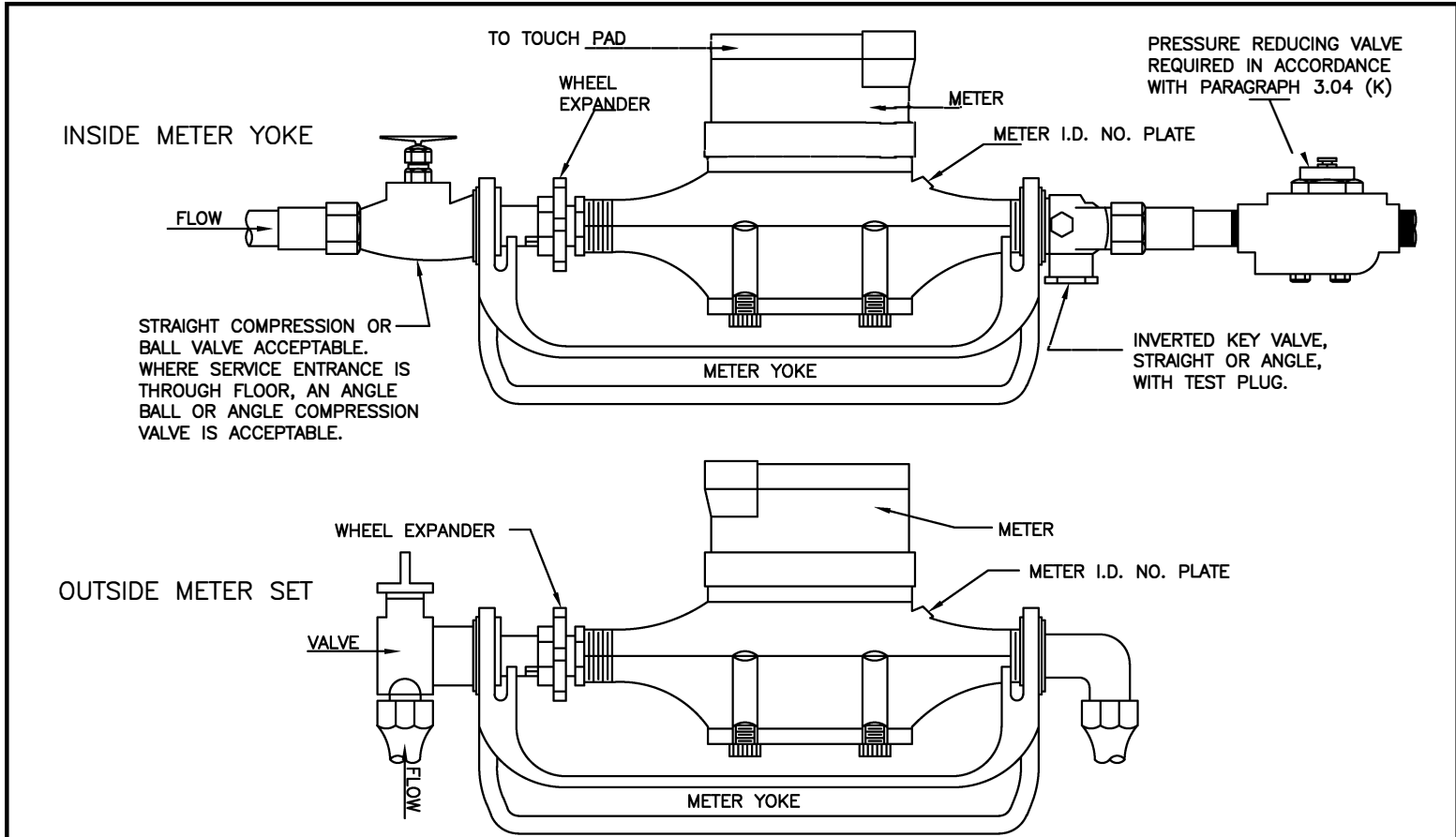
Ordinary Embedment

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DRAWN Modified 2013	DATE
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EMBEDMENTS FOR WATER MAINS

SIZE A	FSCM NO.	DWG NO. Wtr - 6	REV
SCALE NONE	SHEET 1 OF 1		



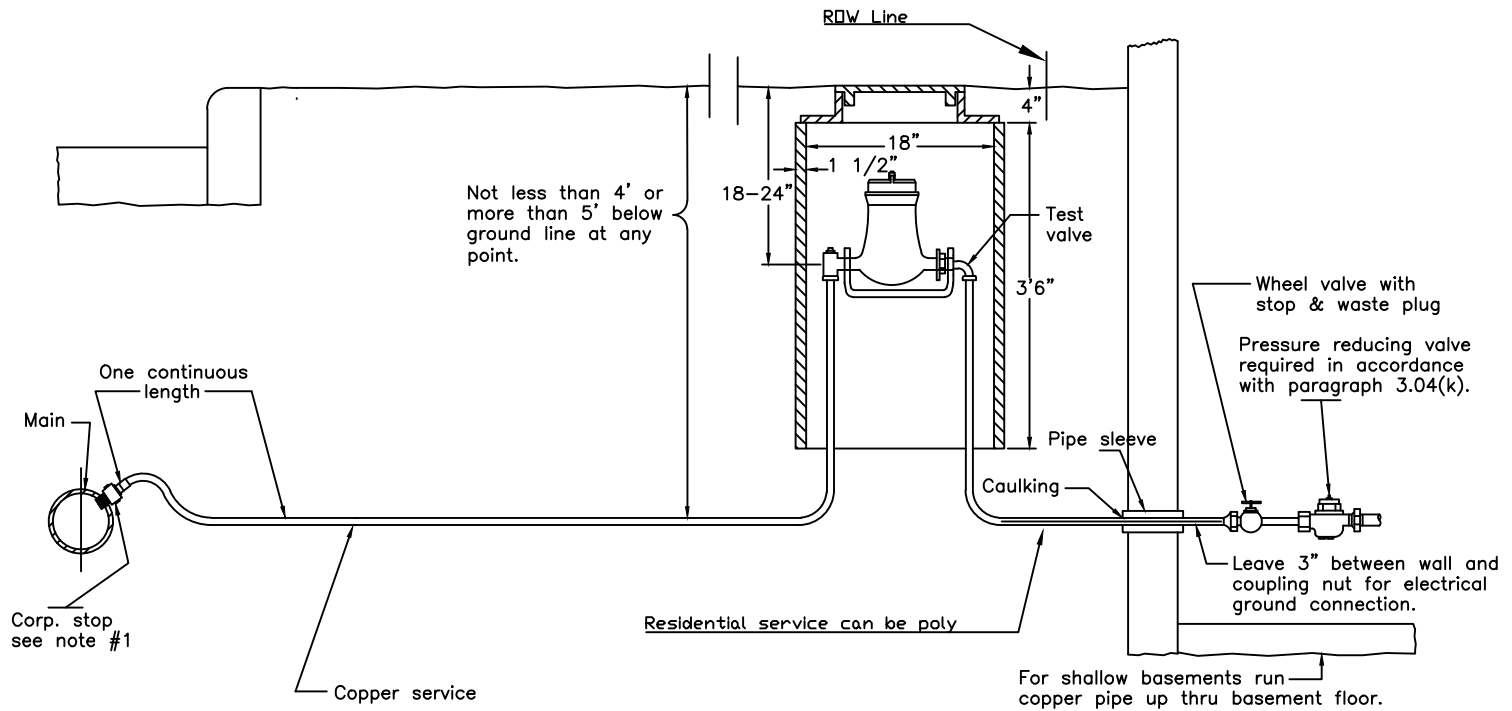
100 Series for straight connections  
200 Series for angle connections

Copper Service Pipe Size Type K	Meter Yoke Ford Straight Line Yoke		Meter Size	Copper Service Pipe Size Type K	Meter Yoke McDonald Straight Line Yoke		Meter Size	<b>PLANNING &amp; ENGINEERING</b> 100 MUNICIPAL CIRCLE RAYMORE, MO 64088 (816)331-0488 FAX (816)331-8067	<b>CITY OF RAYMORE</b>  METER SETTINGS				
	Inside Set	Outside Set			Inside Set	Outside Set							
3/4"	121 & 221	513	5/8"	5/8"	14-1--BKCE33	14-1--BJCC33	5/8"	DRAWN JPB	DATE 2016	SIZE A	FSCM NO.	DWG NO. WTR - 7	REV
3/4"	123 & 223	515	3/4"	3/4"	14-3--BKCE33	14-3--BJCC33	3/4"	CHECKED		SCALE		SHEET	OF
1"	124 & 224	516	1"	1"			1"	APPROVED					

**NOTES:**

1. Corp stops installed by Water Dept.
2. All service piping to be copper type K.
3. Remote register required on all inside meter installations per paragraph 5.04(g).

SERVICE LINE REQUIREMENTS			
Service Size	Corp. Size See Note #1	Curb Stop Size See Note #2	Meter Size
3/4"	3/4"	3/4"	5/8" or 3/4"
1"	1"	1"	1"



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Outside Installation for 3/4" & 1" Services			
DRAWN JPB	DATE 2016	SIZE <b>A</b>	FSCM NO.
CHECKED		DWG NO. WTR - 8	REV
APPROVED		SCALE	SHEET OF