

City of Moscow Mills, Missouri Water Distribution System Construction Standards

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TABLE OF CONTENTS

<u>Section</u>	<u>Page(s)</u>
A. General Requirements.....	2-3
B. Location of Lines & Appurtenances.....	3
C. Water Main Pipe.....	3-5
D. Water Main Equipment.....	5-6
E. Casings for Street Bores.....	6
F. Excavation.....	6-8
G. Dewatering.....	8
H. Bedding.....	8-9
I. Installation of Water Pipe and Appurtenances.....	9-16
J. Protection of Water Lines Near Sanitary Sewers.....	16-17
K. Inspection & Test.....	17-20
L. Contractor's Responsibility.....	20

TABLE 1 – Maximum Permissible Deflection in Laying Mechanical-Joint Pipe 21

TABLE 2 – Maximum Permissible Deflection in Laying Push-on Joint Pipe Ductile Iron or Cast Iron..... 22



City of Moscow Mills, Missouri

Water Distribution System

Construction Standards

A. General Requirements

1. All water mains shall be profiled on the construction plans. All water mains of any size that are not under a designed street shall also be profiled on the construction plans.
2. All contractors must notify the City at least 48 hours prior to start of construction.
3. No work shall be backfilled until the construction has been inspected and approved by a qualified inspector employed by the City of Moscow Mills.
4. The maximum distance between main line gate valves shall be 800 feet. Gate valves shall be located so that no more than 15 lots will be out of service with the closing of any two (2) valves. Gate valves shall also be located at all intersections.
5. Meters shall be supplied by the City of Moscow Mills.
6. Fire hydrants shall be Mueller Centurion 250 type with six (6) inch isolation valves and shall be spaced as follows:
 - a. Single and multi-family residential areas shall have maximum fire hydrant spacing at 600 feet.
 - b. All other areas shall have maximum fire hydrant spacing of 300 feet.
7. Steel and PVC pipe installed only with prior approval of the City Engineer.
8. Service line shut-off valves and service meter vaults shall be located outside street right-of-way on customer property.
9. Water mains shall not be located in tree lawn areas (areas between back of curb and sidewalk).
10. Depth of cover shall be 3 feet minimum below finished grade.
11. All water mains shall have a 10-foot separation from any parallel sewer.
12. A minimum vertical clearance of 18 inches between water mains and sewers.

13. On all water mains to be extended in the future, install a 10-foot stub with gate valve and plug for future connection.
14. Gate Valves are not allowed in pavement area.
15. At high points in water mains where air can accumulate, provisions shall be made to remove the air by means of air relief valves.
16. Service lines shall have minimum diameter of 3/4 inches and have separate corporation stops, shut-off valves ("stop coils), shut-off valve box and lid, meter and pressure reducing valve.
17. All PVC under main shall have tracer wire installed.

B. Location of Lines and Appurtenances

1. Water mains in street right-of-way.
 - a. No water main shall be constructed longitudinally under street pavement or under sidewalk.
 - b. No water main shall be constructed in tree lawn area (area between back of curb and edge of sidewalk). Trees will be planted in this area.
2. Water Mains in Easement
 - a. The developer shall grant the City of Moscow Mills a five (5) foot easement adjacent (adjoining) to the street right-of-way line. The entire length of street, for the construction of water mains. No trees shall be planted in easement.
 - b. All other easements for water mains shall be a minimum of fifteen (15) feet.
3. Valves
 - a. Valves shall be located, where possible, at a point on the main that would be intersected by the extension of a property line.
4. Fire hydrants
 - a. hydrants shall have an easement envelope around them measuring five (5) feet behind the hydrant and ten (10) feet to the sides.
 - b. Fire hydrants shall be located, where possible, on the northeast corner of an intersection a minimum of 18" behind the curb or sidewalk, or a minimum of 24" inside the street right-of-way, and set on the curb return.

C. Water Main Pipe

1. General

- a. All public water mains will be a minimum of 6" in diameter. Sizing shall be determined by the City Engineer.

2. Polyethylene Pipe (HDPE)

- a. All water mains shall meet the requirements of Polyethylene (PE) Pressure Pipe and Fittings, 4 inch Through 63 inch for Water Distribution and Transmission, AWWA C906 or latest revision thereof and shall be DR13.5 with blue striping on the exterior. All mains up to 12 inch in diameter shall be IPS and all mains 12 inch in diameter or larger shall be DIPS. Pipe, tubing and fittings shall be homogeneous throughout, and free of visible cracks, holes, foreign inclusions, blisters, dents, or other injurious defects. The pipe, tubing, and fittings shall be as uniform as commercially practicable in color, opacity, density, and other physical properties.

3. Ductile Iron Pipe (D.I.P.)

- a. All ductile iron pipe furnished under this specification shall be manufactured in strict accordance with AWWA standard specification C-151/A21.51-81 or latest revision thereof with the following additional requirements:
 - Joint Type - All ductile iron pipe joints shall be "push on joint single gasket" or "Mechanical joint ingle gasket." The rubber gasket shall conform to the requirements of AWWA C-121.11-80, or latest revision thereof.
 - Thickness class - Pipe furnished shall be class 50 for sizes through 18 inch in diameter and class 51 for all other diameters.
 - Laying Length - Pipe furnished shall have a normal laying length of 18' or 20'.
 - Grade of Iron - Iron used in the manufacture of pipe shall have 60/42/10 physicals.
 - Cement Mortar Lining - All pipe furnished shall have standard thickness cement mortar lining in accordance with AWWA C-104/A21.4-80 or latest revision thereof.

3. Polyvinyl Chloride Pressure Pipe (PVC)

- a. Casings for water service lines shall be 2 inch in diameter, schedule 40 PVC, and shall be installed prior

to street paving at locations as shown on the approved plans.

D. Water Main Equipment

1. Fittings

a. Polyethylene Pipe Fittings:

1. Butt Fusion Fittings - Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-99. Butt Fusion Fittings shall have a manufacturing standard of ASTM D3261. Molded & fabricated fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Fabricated fittings are to be manufactured using a Data Logger. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the quality control records.

2. Electrofusion Fittings - Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-99. Electrofusion Fittings shall have a manufacturing standard of ASTM F-1055. Fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Electrofusion couplings and saddles may only be used with the approval of the City.

b. All ductile iron fittings shall be cement mortar lined, and shall conform to AWWA C-110/A21.10-82 for mechanical joints and AWWA C-111-71 or ANSI A21.11 for push on joint gasket or latest revision thereof.

2. Valves and Hydrants

a. Gate Valves - shall conform to AWWA C-500-80 (or latest revision) flexible wedge, with a minimum working water pressure of 200 PSIG for valves 12" and smaller. Valve seats, the discs and the stem shall be constructed of bronze. Stem seals shall be with two "O" ring, each of which shall be designed as to allow replacement under full line pressure when the valve is in the fully open position. Valves shall have 2" square operating nuts and shall open clockwise (right) unless otherwise directed by the City. Gate valves shall be manufactured by Mueller, 2360 Series Resilient Wedge gate valves.

- b. Fire Hydrants - shall conform to AWWA C-502-73 or latest revision. Hydrants shall have a 6" bell connection, two 2-1/2" hose connections and one 4-1/2" pumper connection. Threads on the pumper and hose connections shall conform to the "National Standard Screw Threads for Fire Hose Couplings and Fittings" published by the Insurance Services office. Hydrants shall be designed to operate under 150 PSI working pressure and shall open clockwise (right) unless specified otherwise. Fire hydrants shall be cast iron and bronze mounted. Fire hydrants shall have auxiliary 6" gate valve anchored directly to or as near as possible to the main line tee as shown in the details in section II. The hydrant lateral shall be 6" ductile iron, shall be wrapped in polyethylene, and shall be rodded or mechanically restrained from tee to hydrant shoe. Hydrants shall be manufactured by Mueller, Centurion model 423 with bronze bushed shoe and o-ring seals. Color: yellow.
- c. Valve Boxes - shall be screw type valve box with stay-put cover marked "WATER", as manufactured by clow, model F-2454.
- d. Combination Air Relief Valves - shall be installed at each high point on all water mains and at all other locations as directed by City. Shall have 2" male NPT connection, body of valve shall be made of reinforced Nylon, shall have 2" ball valve installed between the pipe and valve. Shall have working pressure range of 2-230 psi and shall be self-cleaning. Valve shall be manufactured by A.R.I., model D-040 combination air valve. Valve shall be enclosed in pre-cast concrete vault with a min. den. of 3'-0" and cast-iron cover and frame, bottom of vault can be crushed stone, to allow for drainage.
- e. Tapping PVC, DIP or AC pipe: Tapping Sleeves shall be manufactured from all stainless steel group 18-8, material 304 including sleeve, outlet neck, outlet flange, and all bolts and nuts; top of shell shall be a minimum of 11 Ga. plate and bottom of shell shall be a minimum of 14 Ga. plate; seal to be full circumferential gridded and approved for potable water; flanged outlets shall be indexed per MSS-SP 60 to accept tapping valves with an ANSI 150 lb. drilling IAW AWWA C207; neck to accept full sized cutter.

Acceptable manufacturers are: Mueller Company;

Smith-Blair; Ford Meter Box or approved equal.

- f. Tapping HDPE pipe: Tapping Sleeves shall be manufactured from HDPE material, rated for hot fusion connection to HDPE pipe, and wet tap of main. Stainless steel or other non-HDPE material tapping sleeves shall not be used when tapping HDPE C906 Polyethylene main. Electrofusion couplings and saddles may only be used with the approval of the City.

- g. Restraints - Mechanical joint fittings shall be restrained by a device, which consists of multiple individually activated gripping surfaces built into a mechanical joint follower gland. Device shall be manufactured from ductile iron conforming to ASTM 536.80. The restraining device shall be such that it can replace a standardized mechanical joint gland and can be used with any standard mechanical joint bell conforming to ANSI/AWWA C111/A21.11 and to ANSI/AWWA C153/A21 of the latest revision. The device shall utilize torque sensitive, "twist off nuts" that shall be incorporated in the design, or the wedge activation screws to insure proper torque. The restrained device shall have a published working pressure rating 350 PSI in sizes through 16" and 250 PSI above 20".

This type of restraint is only suitable for use on DIP or PVC pipe. When connecting to HDPE pipe, the use of standard MJ Adapter with a Ductile Iron MJ gland, is the only acceptable method for connecting from HDPE pipe to valves and/or fittings.

Acceptable manufacturers and models: Restraint device for mechanical joints shall be Uni- flange series 1500 manufactured by the Ford Meter Box Company of Wabash, Indiana, or 2000 series Megalug Manufactured by EBAA Iron Sales, Inc. of Eastland, Texas or approved equal.

- h. Tracer Wire - A coated number 12 AWG solid strand copper tracer wire shall be installed the entire length of the water main within six (6) inches of the top of the pipe. The tracer wire shall be run up the outside of all valve boxes and tucked under the lid and shall be run inside all air release valve vaults and shall continue through the vault. A minimum of 5 feet of wire should be neatly coiled inside vault, for connection to tracing equipment.

Any project with over 1500 feet of pipe shall use a 2500' roll of tracer wire. 3M splice kits shall be utilized for all tracer wire splicing.

Any project where fire hydrants, or valves, are over 600' apart, tracer wire with a connecting box must be installed every 500'. The connecting box will be either a standard valve box, to be used in improved areas or a Carsonite Scepter Telecommunications Test Station, as shown in SCD 500.03, with white post and cap made of Lexan material, for use in unimproved areas.

E. Casings for Street Bores.

1. All bores shall have a steel casing pipe conforming to all applicable requirements of AWWA C200-86 and AWWA M11, and if fabricated shall be constructed of A36 steel with a minimum yield point of 36,000 psi; or if manufactured shall conform to Grade B with a minimum yield point of 35,000 psi. It may be shipped in random lengths between 18 and 22 feet and shall have one end cut square and one end beveled.

All casing pipe to be joined with 360-degree welds. It shall be mill primed and coated with coal tar epoxy 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. Steel casing pipe shall have a minimum wall thickness as indicated on the table below.

Casing Pipe Diameter	Casing Pipe Minimum Wall Thickness
6" thru 12"	0.188"
14" thru 22"	0.250"
24" & 26"	0.281"
28" thru 34"	0.312"
36" thru 48"	0.344"

2. The carrier pipe shall be prevented from contact with the casing pipe by means of polyethylene spacers, placed every 10 feet maximum along the carrier pipe. Closer spacing may be necessary based upon recommendations of the manufactures of the spacers. Polyethylene spacers shall be: RACI Spacers, Pipeline Seal & Insulator, Inc.; Ranger Type II, Advance Products & Systems, Inc. Model SSI or CI.

3. Other casing pipe materials may be allowable if approved by the City on a case by case basis.
- 4.

F. Excavation

1. General - Excavation for pipelines, fittings, and appurtenances shall be open trench to the depth and in the direction necessary for the proper installation of the same as shown on the approved drawings or as otherwise approved by the City. Any water that may be encountered or may accumulate in the excavation shall be pumped out or otherwise removed as necessary to keep the bottom of the excavation free and clear of water during the progress of work.
2. Limit of Excavation - Except by expressed written permission of the City, the maximum length of open trench shall be 600', or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is smaller. The distance is the collective length at any location, including open excavation, pipe laying and appurtenances, construction and backfill that has not been temporarily resurfaced. No trench shall be left open at any time that the Contractor is not on the job site engaged in construction operations.
3. Trench Width - The overall trench width shall not be more than 24" nor less than 12" wider than the largest outside diameter of the pipe to be laid therein, measured at the top of the pipe, exclusive of branches. Excavating and trenching shall be true to line so that a clear space of not more than 12" or less than 6" in width is provided on each side of the largest outside diameter of the pipe for proper placement and densification of the bedding or backfill. For the purpose of this section, the largest outside diameter shall be the outside diameter of the bell, on bell and spigot pipe.
4. Excavation Below Grade - the trench shall be excavated to a minimum depth of 6" below the bottom of the pipe. Before the pipe is laid, the subgrade shall be made by backfilling with an approved material in 3" uncompacted layers. The layers shall be thoroughly tamped as directed by the City to provide a continuous bearing and support for the pipe at every point between coupling or bell holes, except that it will be permissible to disturb and otherwise damage the finished surface over a maximum length of 18" near the middle of each length of pipe by the withdrawal of pipe slings or other

lifting tackle. The finished subgrade shall be prepared accurately by means of hand tools.

5. Trenching By Hand or Machine - Hand methods for excavation shall be employed in locations directed by the City. In other locations, the Contractor may use trench digging machinery or employ hand methods.
6. Bracing Excavations - All excavations shall be properly supported in the manner as required by Occupational Safety and Health Administration Federal Register Vol. 37, No. 243, sub-part P, Section 1926.652 or as required by State laws and Municipal ordinances and as may be necessary to protect life, property, the work, or as ordered by the City. Excavations shall be braced, sheeted and supported such that they will be safe, and the ground alongside the excavation will not slide or settle. Excavation shall be so braced or sheeted so as to provide conditions under which workmen may work safely and efficiently at all times. The sheeting, shoring and bracing shall be so arranged as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.

Care shall be exercised in the drawing or removing of sheeting, shoring bracing and timbering to prevent the caving or collapsing of the excavation faces that are being supported.

7. Grading and Stockpiling - the Contractor shall control grading in a manner to prevent water from running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm and wastewater can be uninterrupted in existing gutters, other surface drains or temporary drains.

G. Dewatering

1. The Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. Dewatering shall be accomplished by methods that will insure a dry excavation and preservation of the bottoms of excavations. Said methods may include well points, sump pumps, suitable rock or gravel placed below the required bedding for drainage and pumping purposes, temporary pipelines and other means, all subject to the approval of the City. Dewatering for the water lines shall commence when groundwater is first encountered and shall be continuous until

such time as water can be allowed to rise in accordance with the provisions of this section.

2. The Contractor shall dispose of the water from the work in accordance with State and Federal laws and with respect for adjacent properties and new construction.

H. Bedding

1. All pipe shall be placed on a bedding material of uniformly graded rock between 3/4-inch minus material, similar to an MSD Type 3, to provide a compacted foundation cushion with minimum allowable thicknesses of 4" under the outside diameter of the pipe.
2. Foundation in Poor Soil - If excessively wet, soft, spongy, unstable or similarly unsuitable material is encountered at the surface upon which the bedding material is to be placed, the unsuitable material shall be removed to a depth as determined in the field by the City Engineer.
3. Foundations in Rock - Where rock is encountered, it shall be removed below grade and the trench backfilled with rock uniformly graded between 3/4-inch and 1 1/2-inches to provide a compacted foundation cushion with minimum allowable thicknesses of 3" under the outside diameter of the pipe bell and 6" under the pipe barrel. Material, other than what has been stated, can be used if accepted by the City and necessary agencies. Whether or not the foundation material will be considered as rock and require bedding as described above will be determined by the City.
4. Pipe Clearance in Rocks - Ledge rock, boulders and large stones shall be removed to provide a clearance of at least 6" below and on the side of the pipe and fittings.
5. The Contractor shall be responsible for accurately shaping the pipe subgrade to fit the bottom of the pipe.

I. Installation of Water Pipe and Appurtenances

1. General - All work shall be in the best practices of the water utility industry and the American Water Works Association, and in accordance with all applicable Federal, State and local codes and regulations. Further, it shall be the responsibility of the Contractor/Developer to obtain all permits necessary for the performance of the work plus completion of the following:
 - a. The Contractor/Developer shall conduct his work so

as not to interfere with the present operation of the existing City's system. If any work interference is encountered between the City and the Contractor/Developer, the City will receive priority in scheduling.

- b. No work shall be performed under conditions, which in the opinion of the City would adversely affect the quality of the finished job.
 - c. Any damage done to the City's system by the Contractor/Developer or his affiliates shall immediately be repaired, to the satisfaction and direction of the City by the Contractor/Developer at their own expense.
2. Alignment and Grade - The water line shall be laid and maintained to the required lines and grades as shown on the plans.

Whenever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the approved plans is required, the City shall have the authority to change the plans and order a deviation from the line and grade.

3. Lowering of Water Main Material into the Trench - proper implements, tools and equipment satisfactory to the City shall be provided and used by the Contractor for the safe and convenient performance of the work. All polyethylene pipe, fittings, valve assemblies, and hydrant assemblies shall be carefully lowered into the trench by means of an approved nylon sling, in such manner as to prevent damage to pipe, fitting or assemblies. Under no circumstances shall pipe, fittings or assemblies be lowered into the trench by means of a metallic cable, chain or sling. Also, under no circumstances shall pipe or accessories be dumped, dropped or rolled into the trench

If damage occurs to any pipe, fittings, valves, hydrants or water main accessories in handling, the damage shall be immediately brought to the City's attention.

4. Inspection Before Installation - All pipe and fittings shall be carefully examined for cracks and other defects while suspended and before installation. Spigot ends shall be examined with particular care as this area is the most vulnerable to damage from handling. Defective pipe or fittings shall be laid aside for inspection by the City, who will prescribe corrective repairs or rejection.

5. Cleaning of Pipe and Fittings - The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean by the Contractor until the pipe has been placed into service. All joint surfaces shall be kept clean until the joint is completed. Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing, or other materials shall be placed in the pipe.
6. Laying of Pipe - Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipelaying crew cannot put the pipe into the trench and place it without getting earth into it, the City may require that before lowering the pipe into the trench, a heavy tightly woven canvas bag of suitable size, or plastic caps, shall be placed over each end and left there until the connection is made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

The pipe shall be secured in place with approved backfill material tamped under it as needed. Precautions shall be taken to prevent dirt from entering the joint space.

7. Cutting of Pipe - The cutting of ductile iron pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe.
8. Polyethylene Pipe Fusion – Section of polyethylene pipe should be joined into continuous lengths on the jobsite above ground.

The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 degrees Fahrenheit, alignment, and an interfacial fusion pressure of between 60 & 90 PSI, which is dependent upon pipe diameter. The butt fusion joining shall produce a joint weld strength equal to or greater than the tensile strength of the pipe itself. All welds will be made using a Data Logger to record temperature, fusion pressure, with a graphic representation of the fusion cycle shall be part of the Quality Control records. A copy of all data logger records shall be provided to the City prior to the main being placed into service.

- a. Securing the pipe: Each component that is to be fused must be held in position so that it will not move unless it is moved by the clamping device.
- b. Facing the pipe: The pipe ends must be faced to establish clean, parallel mating surfaces. Facing is continued until a minimum distance exists between the fixed and movable jaws of the machine and the facer is locked firmly and squarely between the jaws. This operation shall provide for a perfectly square face, perpendicular to the pipe centerline on each pipe end and with no detectable gap.
- c. Aligning the pipe: The pipe profiles must be rounded and aligned with each other to minimize mismatch (high-low) of the pipe walls. This can be accomplished by adjusting clamping jaws until the outside diameters of the pipe ends match. The jaws must not be loosened or the pipe may slip during fusion.
- d. Melting the pipe: Heating tools that simultaneously heat both pipe ends are used to accomplish this operation. These heating tools are normally furnished with thermometers to measure internal heater temperature so the operator can monitor the temperature before each joint is made. However, the thermometer can be used only as a general indicator because there is some heat loss from internal to external surfaces, depending on factors such as ambient temperatures and wind conditions. A pyrometer or other surface temperature-measuring device should be used periodically to insure proper temperature of the heating tool face. Additionally, heating tools are usually equipped with suspension and alignment guides that center them on the pipe ends. The heater faces that come into contact with the pipe should be clean, oil-free and coated with a nonstick coating as recommended by the manufacturer to prevent molten plastic from sticking to the heater surfaces. Remaining molten plastic can interfere with fusion quality and must be removed according to the tool manufacturer's instructions. Plug in the heater and bring the surface temperatures up to the temperature range of between 400-450°F (204-232°C). Install the heater in the butt fusion machine and bring the pipe ends into full contact with the heater. To ensure that full and proper contact is made between the pipe ends and the heater, the initial contact should be under moderate pressure. After holding the pressure very briefly, it should be released without

breaking contact. Continue to hold the components in place, without force, while a bead of molten polyethylene develops between the heater and the pipe ends. When the proper bead size is formed against the heater surfaces, the heater should be removed. The bead size is dependent on the pipe size.

The approximate melt bead sizes shall be as follows:

<u>Pipe Size</u>	<u>Approximate Melt Bead</u>
Size 2" through 3"	1/16"
3" through 8"	1/8" – 3/16"
8" through 12"	3/16" – 1/4"
12" through 24"	1/4" – 7/16"
24" through 36"	7/16"

- e. Joining the pipe: After the pipe ends have been heated for the proper time, the heater tool is removed and the molten pipe ends are brought together with sufficient force to form a double rollback bead against the pipe wall. The fusion force is determined by multiplying the interfacial pressure, 60-90 psi (4.14-6.21 bar), by the pipe area. For manually operated fusion machines, a torque wrench may be used to accurately apply the proper force. For manual machines without force reading capability of a torque wrench, the correct fusion joining force is the force required to roll the melt beads over to the pipe surface during joining. For hydraulically operated fusion machines, the fusion force can be divided by the total effective piston area of the carriage cylinders to give a hydraulic gauge reading in psi. The gauge reading is theoretical; the internal and external drag need to be added to this figure to obtain the actual fusion pressure required by the machine.
- f. Holding the pipe: The molten joint must be held immobile under pressure until cooled adequately to develop strength. Allowing proper times under pressure for cooling prior to removal from the clamps of the machine is important in achieving joint integrity. The fusion force should be held between the pipe ends until the surface of the bead is cool to the touch. The pulling, installation or rough handling of the pipe should be avoided until the joint cools to ambient temperature.
- g. Electrofusion Couplings and Saddles: Electrofusion couplings and saddles may only be used with the approval of the City.
- h. Polyethylene Pipe Fusion License – C906

polyethylene pipe fusion operations must be conducted by an individual in possession of a valid Fusion License.

10. Joining of Polyethylene Pipe to Valves. Polyethylene pipe shall be joined to all valves by means of a MJ adapter and back-up ring for each valve face. Where MJ adapters are to be used, MJ faced valves shall also be used
11. Jointing of Mechanical Joint Pipe
 - a. Cleaning and Assembly of Joint - The last 8" of the outside spigot and inside bell of mechanical joint pipe shall be thoroughly cleaned to remove oil, grease, grit, excess coating and other foreign matter from the joint and then painted with a soap solution made by dissolving 2 cup of liquid soap in 1 gallon of water. The cast iron gland shall be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket, or bell end. The rubber gasket shall be painted with the soap solution and placed on the spigot end with the thick edge towards the gland.
 - b. Bolting of Joint - The entire section of pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell. Care should be taken to locate the gasket evenly around the entire joint. The cast iron gland shall be moved along the pipe into position for bolting, all of the bolts inserted, and the nuts screwed finger tight. All nuts shall be tightened with a torque limiting wrench. The torque for various sizes of bolts shall be as follows:

Pipe Size (Inches)	Bolt Size (Inches)	Range of Torque Min. (Ft-#) Max.
3	5/8	45-60
4-24	3/4	75-90
30-36	1	100-120
42-48	1-1/4	120-150

Nuts spaced 180 degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland.

- c. Permissible Defection in Mechanical Joint Pipe - Whenever it is desirable to deflect mechanical joint pipe in order to form a long radius curve; the amount of Defection shall not exceed the maximum limits shown in Table 1 at the end of this section.

12. Jointing Push-on Joint Pipe
 - a. Cleaning and Assembly of Joint - the inside of the bell coupling and the outside of the spigot end shall be thoroughly cleaned to remove oil, grit, excess coating and other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket, or the coupling end of polyvinyl chloride pipe.
 - b. A thin film of gasket lubricant shall be applied to either the inside surface of the gasket or the outside of the spigot end of the pipe or both. Gasket lubricant shall be supplied by the pipe manufacturer and approved by the City.
 - c. The spigot end of the pipe shall be placed into the bell or coupling end, without touching the ground with the spigot end after cleaning. The joint shall then be completed by forcing the plain end to the bottom of the socket. Pipe shall be marked with a depth mark to insure that the spigot end is inserted to the full depth of the joint. Field-cut pipe lengths shall be marked by painting or file mark. The spigot end shall be ground or filed to resemble manufacture pipe end. Complete assembly instructions shall be provided by the pipe manufacturer.
 - d. Permissible deflection in Push-On Joint Pipe - whenever it is desirable to deflect push-on joint pipe, in order to form a long-radius curve, the amount of deflection shall not exceed the maximum limits shown in Table 2 at the end of this section for cast iron or ductile iron pipe, or 4 degrees coupling for polyvinyl chloride pipe.
13. Installation of Water Line Valve Boxes
 - a. Valve Boxes and Valve Vaults - A valve box or valve vault shall be provided for every valve.
 - b. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement or embedded in an 18" square by 6" thick concrete pad when placed in an area that is not paved.
 - c. All valve boxes shall be left 2 feet above approximate finished grade until the final lot grading is completed. At that time it shall be cut down to meet the finished grade.

14. Installation of Fire Hydrants
 - a. Position - All hydrants shall stand plumb and shall have their pumper nozzles at right angles to the main line, unless otherwise directed by the City. Hydrants shall be set to established grade, with nozzles at least 18" above the ground, or as directed by the City. The bottom flange of the hydrant shall be set 3" above the finished grade. No portion of the fire hydrant may protrude into the sidewalk area.
 - b. Connection to Main - Each hydrant shall be connected to the main with a minimum 6" ductile iron branch controlled by an independent 6" gate valve located next to mechanical joint tee with a 6" anchor coupling. The branch line shall be rodded and wrapped, and the hydrant shoe and main line tee shall be thrust blocked.
 - c. Hydrant Drainage - A drainage pit 3' in width and 3' deep shall be excavated below each hydrant and filled completely with coarse gravel or crushed stone mixed with coarse sand, under and around the shoe of each hydrant and to a level 6" above the top of the pipe lateral to allow for proper drainage. Lateral Offsets-6" ductile iron manufactured offsets may be used on the branch line to allow proper elevation settling of the hydrant shoe.
15. Anchorage
 - a. Anchorage - All plugs, valves, bends, reducers, tees, and fire hydrants shall be anchored by thrust blocks and rods and clamps.
16. Loops
 - a. Water mains should be looped and dead- end water mains avoided whenever possible. If dead-end mains are unavoidable, flushing devices should be installed at the termini of the dead-end water mains and an operational plan should be implemented to routinely flush the dead-end mains. If water mains will be separated by a closed valve thereby creating static conditions (as in the case of pressure zone boundaries for example), flushing devices should be installed on both sides of the closed valve.
16. Mains in Cul-De-Sacs
 - a. Whenever possible, all water main systems shall be designed to provide a complete system loop with all portions of the system having possible feed from at least two directions. This is generally not possible or required in cul-de-sacs.

- That all lots have access to the main at a point back of the curb.
- That taps for all water services can be made on a portion of the main abutting the property to be served.
- That a fire hydrant be installed at the end of the main, opposite a lot line between abutting lots.

17. Backfilling

- a. General - All trenches shall be backfilled after pipe, fittings and appurtenances have been installed, inspected and approved by the City.
- b. Density Requirements in Trench - the Contractor shall obtain a Standard Proctor Density of 90% for the total depth of all trenches in open fields and 95% in dedicated rights-of-way. Backfilling shall be done with good sound earth, sand or gravel, and no oil cake, bituminous pavement, concrete, rock or other lumpy material shall be used in the backfill unless these materials are scattered and do not exceed 6" in any dimension and are not placed within one foot of the 2-½' limit. Material of perishable, spongy or otherwise improper nature shall not be used in backfilling and no material greater than 4" in any dimension shall be placed within 1' of any pipe, manhole or structure. Backfilling shall be accomplished in the zone in layers not to exceed 3'. All backfill material shall be subject to the approval of the City.
- c. Compacted Fill - Compaction shall be done by use of vibratory equipment, tamping rollers, pneumatic tire rollers or other mechanical tampers, of the type and size approved by the City. The backfill shall be placed in horizontal layers of such depths as are considered proper for the type of compacting equipment being used in relation to the backfill material being placed. Each layer shall be evenly spread, properly moistened and compacted to the specified density. Any damage to the pipe as a result of Contractor's operation shall be repaired and/or replaced.
- d. Consolidated Fill - Consolidated fill shall be performed by flooding, pooling or jetting so as to obtain a relative density of the fill material at least equal to that specified. When flooding, pooling or jetting are used, material for use as backfill shall be placed and compacted in layers not exceeding 3' in thickness. Flooding, pooling or jetting methods shall be

supplemented by the use of vibratory or other compaction equipment when necessary to obtain the required density. Care shall be taken in all consolidating operations to prevent the movement or floating of the pipe. In the event there is movement or floating, the Contractor shall re-excavate, relay and backfill all pipe so affected. Consolidation methods shall not be used when the backfill material is not sufficiently granular in nature to be self-draining during and after consolidation and foundation materials may be softened or otherwise damaged by applied water.

- e. Procedure at Street Zone - The top 2-1/2' from finish street grade or ground surface, as the case may be, shall be compacted in horizontal layers not exceeding 6" in thickness, using approved hand pneumatic or mechanical type tampers to obtain a Standard Proctor Density of 95%. Flooding and jetting will not be permitted in this upper 2-1/2'. From existing street grade to 2-1/2" in diameter, in quantity not exceeding 20% of the volume where said coarse materials are well distributed throughout the finer material and the specified compaction can be obtained.

18. Compaction Tests

- a. When required by the City, compaction tests will be taken by an approved testing laboratory at locations designated by the City. All expenses involved in these tests will be borne by the Developer/Owner. Results of the tests will be made available to the City Engineer immediately and copies of test results will be supplied to the City immediately and copies of test results will be supplied to the City once per week. In all cases where the tests indicate compaction less than that required in these specifications, additional compaction and tests will be required until these specifications are met. Probationary acceptance of the lines by the City will be contingent upon satisfactory compaction results. No hydrostatic testing of the water main will be allowed until satisfactory compaction is obtained. Frequency of testing will be as follows:

- 1 test at every above ground appurtenance (i.e. valve box, manhole, hydrant, etc.)
- 1 test for every 1 foot of backfill for every 250 LF of mainline trench
- water service- eighty percent of the test shall be taken within 1 foot of edge of the curb and seventy percent of the test shall be

taken below subgrade as to check for bridging. If water services are to be placed beneath existing curb and/or sidewalk, observation is required to report possible undermining. Undermining shall be immediately reported to the City.

19. Final Clean Up
 - a. After backfill and compaction has been completed, the right-of-way shall be dressed smooth and left in a neat and presentable condition as close to final grade or subgrade as possible and to the satisfaction of the City.

20. Safety Precaution
 - a. All excavations shall be performed, protected and supported as required for safety and in the manner set forth in the operation rules, orders and regulations prescribed by the occupational Safety and Health Administration Federal Register. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely refilled.

21. Mechanical Joint Restraint
 - a. General - All mechanical joint restraints shall be incorporated in the design of a follower gland. The gland shall be manufactured of ductile iron conforming to ASTM A 536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-headed bolts conforming to AWWAC111 and C153.

 - b. Description - The restraint mechanism shall consist of numerous individually activated gripping surfaces to maximize restraint capability. The gripping surfaces shall be wedges designed to spread the bearing surfaces on the pipe. Twist-off nuts, sized same as tee-head bolts, shall be used to ensure proper actuating of restraining devices. When the nut is sheared off, as standard hex nut shall remain.

 - c. Pressure - The mechanical joint restraint device for ductile iron pipe shall have a working pressure of at least 250 psi with a minimum safety factor of 2.

The mechanical joint restraint device for PVC shall have a working pressure of at least 150 psi with a minimum safety factor of 2:1.

- d. acceptable manufacturers for mechanical joint restraint devices are the following:

For Ductile Iron Pipe:

<u>EBAA Iron, Inc.</u>	<u>Megalug 1100 series</u>	<u>(4" - 36")</u>
<u>Uni-Flange</u>	<u>Series 1400</u>	<u>(4" - 12")</u>

For PVC Pipe

<u>EBAA Iron, Inc.</u>	<u>Megalug 2000 PV Series</u>	<u>(4" - 16")</u>
<u>Uni-Flange</u>	<u>Series 1500</u>	<u>(4" - 16")</u>

- J. Protection of Water Lines near Sanitary Sewers
 - a. Water mains shall be located a minimum of 10 feet horizontally from existing or proposed sanitary sewer lines (centerline distance). Where water mains cross house sewers or sanitary sewers, they shall be above sewers and laid to provide a vertical clear distance of at least 18" between the bottom of the water main and the top of the sewer. When a new water main crosses an existing sewer at a point less than 18" above the sewer, the City Engineer shall be notified, and adjustments shall be made. Stability of the water and sewer lines at a point of crossing is critical and care must be taken to ensure proper welding and compaction of both water and sewer lines.
 - b. Where it is not feasible to install a water main above an existing or proposed sewer, e.g., to maintain minimum cover, the water main shall be laid to provide a vertical clear distance of at least 18" between the bottom of the sewer and the top of the water main. When the clear distance is less than 18" the City Engineer shall be notified.
 - c. No water pipe or main shall pass through or, come within 10" horizontally of, any part of a sewer or sewer manhole.

K. Inspection and Test

- 1. Pipe Testing Prior to Construction
 - a. Before being used in any work under these specifications, and when directed by the City, pipe shall be subjected to and shall meet the requirements for testing pipe as established by the American Water Works Association in Specifications, depending on the type of pipe. These tests shall be made by the Contractor and shall be witnessed by reputable testing

laboratory. The Contractor shall deliver the pipe selected for testing to the place and at the time designated by the testing laboratory. Written test reports will be furnished to the City upon request.

- b. The testing laboratory shall select at random for testing as herein specified up to 2% of the number of pipes in each size of pipe furnished, except that in no case shall less than five (5) specimens be tested.
- c. The specimens selected for testing purposes shall be sound pipe having dimensions consistent with the referenced specifications. The lot or lots from which the test samples are taken shall be sufficient to fill the entire order for that size of pipe used in the work under the contract if they pass the tests, shall be so designated and marked.
- d. All pipe shall be subject to inspection at the factory, trench or other point of delivery by the City. The purpose of the inspection shall be to cull and reject any pipe that, independent of the physical tests herein specified, fails to conform to the requirements of the referenced specifications, or that may have been damaged during transportation and/or in subsequent handling.
- e. The City of Moscow Mills reserves the right to reject any and all pipe sections that may contain visual imperfections or imperfections of any type that may be considered by the City to be detrimental to the operation and life of the pipe.

2. Disinfection of Pipe after Installation

- a. Chlorination - All mains, extensions and private pipe shall be chlorinated in accordance with ANSI/SWWA C651-92, "Disinfection Water Mains"

The chlorination of the finished pipelines shall be done prior to the hydrostatic testing.

- b. Material - Chlorine tablets may be used for disinfection in twelve-inch (12") and smaller. For pipes having a larger diameter, a chlorine slurry is fed into the water filling the pipe. If chlorine tablets are used, they shall be attached to the inside top of the pipe with "Red" permatrix just prior to the pipe installation. Hypochlorite may be used and shall conform to Federal specification O-C 114, Type II Grade B.

- c. Method - Flushing and sterilization of lines shall be accomplished in accordance with ANSI/AWWAC651-92. Chlorine dosage shall be at least 50mg per liter and shall be retained in the line at least 24 hours, after which time the residual at the end of the line and at other representative points in the line shall be at least 10mg per liter. If the residual at the end of 24 hours is less than 10 parts per million, the entire operation shall be repeated.
 - d. All valves in the lines being sterilized shall be opened and closed several times during the contact period. After completion of sterilization, the system shall be flushed with clean water until the residual chlorine content is not greater than 1 part per million.
 - e. If chlorine tablets are used, there shall be documentation provided that the tablets were properly secured to the pipe before filling per ANSI/AWWAC651-92. This will be required for the chlorination test to pass.
3. Hydrostatic Pressure test after Installation
- a. The hydrostatic test pressure for HDPE pipe shall conform to ASTM F2164 "Standard Practice for Field Leak Testing of Polyethylene Pressure Pipe Systems Using Hydrostatic Pressure". All sections of newly laid pipe, subsequent to backfilling, shall be subjected to the hydrostatic pressure test.
 - b. The hydrostatic test pressure for any type of pipe shall be 150 pounds per square inch based on the elevation of the lowest point in the line of section under test and carried to the elevation of the test gage. All sections of newly laid pipe, subsequent to backfilling, shall be subjected to the hydrostatic pressure test.
 - c. The duration of the hydrostatic pressure test be at least one (1) hour.
 - d. Air Removal Before Test - Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points as the air can be expelled as the line is filling with water. After all the air has been expelled, the corporation cocks shall be closed, and test pressure applied. Any cracked or defective pipe, fittings, valves, or hydrants discovered in sequence of this pressure test shall be removed and replaced by

the Contractor with sound materials in the manner provided under this specification, and the test shall be repeated until results satisfactory to the City are obtained.

- e. Procedure - Each valved section of pipe shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the City. The pump, pipe connection, gauges and all other necessary equipment and personnel to complete the test, shall be furnished by the Contractor and shall be approved by the City Engineer. All corporation cocks and taps to the main line and all connection piping and valves that may be required to make the test, whether or not specified or shown on the construction drawings, shall be installed by the Contractor.
- f. While the test pressure is maintained, the new pipe will be inspected and any leaks will be repaired. After all leakage has stopped, the pressure of 150 psi shall be maintained for one (1) hour. Allowable leakage for each section between line valves shall not exceed the following values:

**Allowable leakage per 1000 Ft./Pipe
Gallons/Hr.**

<u>Inside Diameter</u>	<u>HDPE</u>	<u>D.I.</u>
4	0.33	0.37
6	0.50	0.55
8	0.66	0.74
12	0.99	1.10
16	1.32	1.47
20	1.66	1.84

- f. Should the leakage rate be greater than the above set rates, the pipeline shall not be accepted. The pipeline shall be repaired, rechlorinated.
- g. The Contractor shall ensure that a satisfactory test is completed and shall employ all methods necessary to pass the test, including disconnection from existing watermains and use of a temporary plug, if necessary.
- h. Once a contractor has passed the initial chlorine test and hydrostatic test, it is imperative that the lines are thoroughly flushed. Hydrants/blow-offs should be opened completely starting at the one closest to the source water and progressing to the end of the line.

Chlorine residual test will be performed at the time of the bacteriological test and the chlorine residual must be within 0.4mg/1 of the source water. If the chlorine residual is higher than the source water, the line has not been adequately flushed and the test fails. If the chlorine residual is lower than the source water, the line may not have been adequately disinfected or lushed and the test fails. If the bacteriological test fails, re-chlorination of the water mains is required.

- L. Contractors Responsibilities
 - a. The Contractor shall be responsible for notifying the City at least 48 hours prior to start of any construction. If work is suspended for any construction. If work is suspended for any period of time after initial start-up, the Contractor must notify the City 48 hours prior to re-start.
 - b. At all points of connection of new water mains to existing mains, the Contractor will be responsible for excavating and verifying location of the existing lines, prior to installation of any new construction. If it is necessary to shut down any portions of the existing water system to make such connection, the Contractor will be responsible for notifying all City customers to be affected by water outage at least 48 hours prior to such outage. All existing water main valves shall be operated only by City Personnel. The duration of water outage to the existing City customers shall be minimized and if directed by the City, the Contractor shall provide temporary water supply to customers by means of tank trucks, temporary connections to charged facilities, etc.
 - c. The Contractor is responsible for maintaining "As-Built" drawings complete showing all changes and important notes,, These "As-Builts" shall be submitted to the City in both a paper copy (2' x 3' Drawings) and AutoCAD format on CD-Rom Format.

TABLE 1**MAXIMUM PERMISSIBLE DEFLECTION IN LAYING MECHANICAL-JOINT PIPE**

Size of * Pipe In.	Maximum Permissible Deflection Per Length - Inches				Approx. Radius of Curve Produced by Succession of Joints - Feet			
	12-Ft. Length	16-ft. Length	18-ft. Length	20-ft. Length	12-ft. Length	16- ft. Length	18-ft. Length	20-ft Length
3	16	22	25		110	145	160	
4	16	22	25		110	145	160	
6	14	19	21		125	170	190	
8	11	14	16		165	220	250	
10	11	14	16		165	220	250	275
12	11	14	16	18	165	220	250	275
14	7	10	11	12	240	320	360	400
16	7	10	11	12	240	320	360	400
18	6	8	9	10	290	380	430	480
20	6	8	9	10	290	380	430	480
24	5	6	7	8	360	480	540	600
30	5	6	7	8	360	480	540	600
36	4	5.5	6	7	430	575	650	720
42	4	5	5.5	6	460	610	690	765
48	4	5	5.5	6	460	610	690	765

TABLE 2

**MAXIMUM PERMISSIBLE DEFLECTION IN LAYING
PUSH-ON JOINT PIPE
DUCTILE IRON OR CAST IRON**

Size of* Pipe In.	Maximum Permissible Deflection Per Length - Inches				Approx. Radius of Curve Produced by Succession of Joints - Feet			
	12-ft. Length	16-ft. Length	18-ft. Length	20ft. Length	12-ft. Length	16-ft. Length	18 -ft. Length	20-ft. Length
3	10	13.5	15	17	175	230	260	290
4	10	13.5	15	17	175	230	260	290
6	10	13.5	15	17	175	230	260	290
8	10	13.5	15	17	175	230	260	290
10	10	13.5	15	17	175	230	260	290
12	10	13.5	15	17	175	230	260	290
14	6	8	9	10	290	380	430	480
16	6	8	9	10	290	380	430	480
18	6	8	9	10	290	380	430	480
20	6	8	9	10	290	380	430	480
24	6	8	9	10	290	380	430	480
30	4	5	6	7	430	575	650	700
36	4	5	6	7	430	575	650	700
42	4	5	6	7	430	575	650	700
48	4	5	6	7	430	575	650	700