

**STANDARD SPECIFICATIONS
FOR**

**WATER MAIN MATERIAL & INSTALLATION
THE MADISON SUBURBAN UTILITY DISTRICT
MADISON, TENNESSEE**



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Introduction

This specification shall apply to all water mains and appurtenances installed within The Madison Suburban Utility District (MSUD) Service Area. All developers, contractors, property owners, etc., installing water mains within the MSUD Service Area, shall therefore comply with these specifications. Plans of proposed installations shall be submitted to the MSUD for review and approval by the MSUD Engineer (Engineer). If applicable, these MSUD approved plans for proposed installations, must then be approved by The Tennessee Department of Environment and Conservation (TDEC), Division of Water Supply, before construction can be authorized by TDEC and the MSUD. The TDEC Division of Water Supply will maintain a copy of these plans in their files. The MSUD provides these Specifications and all MSUD Details on their water system website: www.msud.net.

Qualification of Contractor

Contractors must have satisfactory experience in the work contemplated and must show evidence of experience, if so requested by the MSUD. The MSUD reserves the right to reject any Contractor not showing satisfactory evidence of acceptable experience.

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I. PIPING AND FITTINGS

A. DUCTILE IRON PIPE AND FITTINGS

1. PIPE

Ductile iron shall conform to the latest revisions of ANSI/AWWA-C150/A21.50: 'Thickness Design of Ductile Iron Pipe', and ANSI/AWWA-C151/A21.51: 'Ductile Iron Pipe, Centrifugally Cast, for Water'. Unless otherwise noted, ductile iron pipe shall be Thickness Class 52 for all sizes.

All pipe shall be cement-mortar lined. Lining shall conform to latest revisions of ANSI/AWWA-C104/A21.4: 'Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.' A bituminous seal coat shall be applied to the cement lining in accordance with the pipe manufacturer's standard practice.

Mechanical and push-on joints conforming to the latest revisions of ANSI/AWWA C111/A21.11: 'Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings', shall be used, unless otherwise noted. Flanged pipe and joints shall conform to the latest revisions of ANSI/AWWA C115/A21.15: 'Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges'. Grooved and shouldered joints, conforming to the latest revisions of ANSI/AWWA C606: 'Grooved and Shouldered Joints', shall not be allowed, unless by written permission of the MSUD.

The length of each piece of pipe shall be standard 18 feet to 20 feet laying lengths.

2. FITTINGS

Ductile iron fittings shall conform to the latest revisions of ANSI/AWWA-C110/A21.10: 'Ductile-Iron and Gray Iron Fittings for Water'.

Fittings shall be of the mechanical joint pattern conforming to latest revision of ANSI/AWWA C111/A21.11.

Fittings are to be cement-mortar lined in accordance with latest revisions of ANSI/AWWA-C104/A21.4. Lining shall be bituminous coated.

All fittings shall be ductile iron Pressure Class 350 for 3-inch through 24-inch diameter, and Pressure Class 250 for 30-inch through 48-inch diameter, in accordance with ANSI AWWA C110/21.10. Compact fittings conforming to the latest revisions of ANSI/AWWA C153/A21.53: 'Ductile-Iron Compact Fittings for Water Service', will be accepted.

Protective fusion-bonded epoxy coatings for the interior and exterior surfaces of ductile iron fittings shall conform to the latest revisions of ANSI/AWWA C116/A21.16-03: 'Protective Fusion-Bonded Epoxy Coatings for the Interior

and Exterior Surfaces of Ductile-Iron and Gray-iron Fittings for Water Supply Service’.

3. JOINTS FOR DUCTILE IRON PIPE AND FITTINGS

All joints for ductile iron pipe shall conform to the latest revisions of ANSI/AWWA-C110/A21.10, and ANSI/AWWA-C111/A21.11: ‘Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.’ The joints shall be good for minimum working pressure of 350 psi for pipes less than 20-inch diameter, 300 psi for 20-inch diameter pipes, 250 psi for 24-inch diameter pipes, and 200 psi for pipes 30-inch to 64-inch diameter.

Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing resistance as pressure increases. Glands shall be manufactured of ductile iron conforming to ASTM A536-80. The device shall be EBAA Iron Inc., MEGALUG, American Fast-Grip, American Flex-Ring, American Lok-Ring joints, rated for a minimum working pressure of 250 psi, or equal as approved by MSUD or their engineer.

4. PIPE DISINFECTION

Disinfecting methods for all water mains shall conform to latest revision of ANSI/AWWA C651-99: ‘Disinfecting Water Mains’, and local and state regulations.

II. VALVES AND VALVE BOXES

A. GATE VALVES

Valves 3-24 inches shall be bolted bonnet, resilient-seated type gate valves conforming to AWWA C509: ‘AWWA Standard for Resilient-Seated Gate Valves for Water Supply Service’. The valve shall be cast iron body and gate with resilient seat and bronze stem. The valve shall have fusion bonded epoxy coating on all ferrous surfaces prior to assembly, inside and outside. Valves shall provide bubble tight closure up to 200 psi. The valves shall be hydrostatically tested with twice the specified rated pressure applied to one side of the gate and zero pressure on the other side. The test shall be made in each direction across the gate. The valve shall be Mueller, M&H or Clow.

All gate valves, except as otherwise specified, shall be of the mechanical joint hub end type. Bell-end dimensions shall conform to the latest revision of ANSI/AWWA-C111/A21.11: ‘Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.’ Valves in the distribution system shall have a two-inch standard valve-operating nut.

All gate valves shall be furnished and installed with valve boxes as specified herein.

To minimize water hammer effects, valve operators shall have a minimum number of turns for full valve travel equal to 2-1/2 times nominal valve size.

Example: 6" valve - 15 turns minimum
 8" valve - 20 turns minimum
 12" valve - 30 turns minimum

All valves shall open by turning to the left. See MSUD Details for valve spacing at tees, and when existing valves are to be abandoned

Valves 2-1/2 inch and smaller: MSS SP-80; Class 150, body and bonnet of ASTM B62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Valve shall be Stockham Figure B-120 or approved equal.

B. POST INDICATOR VALVE

Reference MSUD Detail for installation of post indicator valve.

C. BUTTERFLY VALVES

Valves 18-inch and larger shall be butterfly valves of the rubber seated, tight closing type, conforming to latest revisions of ANSI/AWWA C-504: Rubber-Seated Butterfly Valves'. The butterfly valves shall be Class 150B of AWWA Specification C-504, with the following modifications: The valve body shall be of close-grained high tensile cast iron with mechanical joints conforming to the latest revisions of ANSI/AWWA-C111/A21.11: 'Rubber-Gasket Joints for Gray-Iron and Ductile Iron Pressure Pipe and Fittings'.

Valves shall be bubble tight at rated pressures and shall be satisfactory for applications involving throttling service. Valve bodies shall be constructed of cast iron ASTM A-126 Class B. Body thickness shall meet or exceed the requirements of AWWA Specification C-504 for Class 150B valves. Valve discs shall be constructed of ductile iron conforming to ASTM A-536 or cast iron conforming to ASTM A48, Class 40 or alloy cast iron conforming to ASTM A-436, Type 1.

Shafts shall be constructed of either 18-8, Type 304 stainless steel, turned, ground and polished, mechanically secured to the valve disc by the use of 18-8, Type 304, stainless steel taper pins, or high-tensile carbon steel, furnished with permanent rubber static shaft seals and Type 304 stainless steel shaft journals to completely isolate the shaft from line fluid. Non-circular hex shafts will be acceptable.

Valve seats shall be either new natural rubber or synthetic rubber, Buna N compound. Rubber seats may be applied to either the body or the disc. Seats applied to the body shall be simultaneously molded and vulcanized into the body, and seat bond must withstand 75 lbs. pull under test procedure ASTM D-429, Method B. Rubber seats applied to the disc edge shall be vulcanized to an 18-8 stainless steel retainer ring, which shall be clamped to the disc using 18-8 stainless

steel locking screw fasteners. Valves with the rubber seat applied to the disc edge shall also have an 18-8 stainless steel seat integral with the body and machined to provide a permanent, corrosion resistant seating area. Valves employing a complete rubber liner will not be acceptable in any size. Valves shall be fitted with sleeve type bearings. Bearings shall be corrosion resistant and self-lubricating.

All surfaces of the valves shall be clean, dry and free from grease before painting. The valve interior surfaces, except seating surfaces, and the exterior surface shall be evenly coated with black asphalt varnish in accordance with Federal Specification TT-V-51c and AWWA C-504.

Valve operators shall be designed to hold the valve in any intermediate position between full open or fully closed without creeping or fluttering. Valve operators shall be manual and shall be of the traveling nut type. Units shall be designed for buried service and shall be fully gasketed and grease packed. Adjustable mechanical stops shall be provided to stop valve in the fully opened and fully closed positions. The 2" square operating nut shall have cast on it an arrow indicating the direction of turning for opening the valve. All butterfly valves shall be furnished and installed with valve boxes as specified herein. All butterfly valves shall be M&H, Clow or Mueller.

D. VALVE BOXES, FRAMES AND COVERS

Valve boxes are to be made up of pre-cast concrete sections measuring 11" x 13-1/4" inside dimensions and 17" x 19-1/4" outside dimensions with a height of 12" to 15" for valves 8" and over, and 15" to 18" for valves 6" and smaller. Reinforcement shall be placed as shown in MSUD Details and shall be deformed billet or rail steel bars conforming to the requirements of ASTM A615, Grade 60 or ASTM A616, Grade 60, respectively.

Footing blocks for standard concrete valve boxes are to be pre-cast in blocks measuring 12" x 12" x 4". No reinforcing steel is required. Number and placement shall be as shown in the MSUD Detail.

The concrete mixture for valve boxes and footing block shall be one part cement, two parts sand, and four parts No. 2 gravel or crushed stone.

Boxes as manufactured by Cloud or Jarrett Concrete, meeting these requirements, are acceptable to the District.

Valve box frames and covers shall be made of cast iron and meet the requirements of ASTM A-48, Class 30, and the MSUD Detail. John Bouchard #8006 Roadway Type valve box frame and cover, is acceptable.

All casting shall be made accurately to the required dimensions and shall be sound, smooth, clear and free of blemishes or other defects. Defective castings, which have been plugged or otherwise treated to remedy defects, shall be rejected. Contact surfaces of frames and covers are to be machined so that the covers rest securely in the frames with no rocking. The cover shall be in contact with the frame for the

entire perimeter of the contact surface. The cast iron cover shall have the word "WATER" cast into it. Valve boxes shall be installed flush with final grade with concrete collar and suitable for the applicable surface loading. Cast iron frame and cover No. 8006, roadway type, Nashville Standard, as manufactured by John Bouchard & Sons Company of Nashville, Tennessee, or equal, as approved by the MSUD, are acceptable.

III. FIRE HYDRANTS

Fire hydrants shall conform to the latest revision of AWWA C502: Dry-Barrel Fire Hydrants, except as otherwise noted, and furnished and installed at the locations shown on the Drawings. The hydrants shall be of the dry head, breakable type, and shall have two 2 ½" hose nozzles and one 4 ½" pumper nozzle. Thread shall conform to the standards of the National Board of Fire Underwriters. The size of the hydrant's main valve shall be 6 inches. Design, materials, and workmanship shall conform to the latest stock pattern of the line hydrant ordinarily produced by the manufacturer. The hydrants shall have a 6" bell end connection, which shall conform to ANSI/AWWA-C111/A21.11: 'Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings' for mechanical joint, cast iron pressure pipe and fittings. The hydrant shall be set plumb and with not less than 2 cubic feet of broken stone at its base. Reference the MSUD Detail. The hydrant shall be Mueller or American Darling. Reference the MSUD Detail for the situation where existing MSUD fire hydrants are to be removed from service.

IV. AIR RELIEF VALVES AND BLOW-OFFS

Air relief valves shall conform to ANSI/AWWA C512, latest revision and shall be installed at the high points on the lines or as directed by the MSUD. The valve shall be designed for working pressure of three hundred (300) psi and shall be Model 200A.1, as manufactured by APCO Corporation, or equal, as approved by the MSUD. The air valve shall be provided with a stainless steel float of the hollow ball type. It shall be so constructed as to permit any air which accumulates in the line to escape, but shall be watertight. The valve shall be connected to the line by use of a bronze corporation cock and installed in a valve box as described in paragraph II (C). Reference the MSUD Detail for 1" Air Relief Valve. Blow-offs shall be installed per the MSUD Detail for 2" Blow-Offs.

V. PRESSURE REDUCING VALVES

A. MAIN VALVE

The main valve shall be a center guided diaphragm actuated globe valve of either oblique (Y) or angle pattern design. The body and cover shall be cast iron, ASTM A-126 Class B, with bronze seat. The internal and external surfaces of the valve body shall be fusion bonded coated. End connections shall meet the ANSI, ISO, DIN, JIS or other internationally recognized standard required. The body shall have a replaceable non-threaded seat ring that is held in place by setscrews, which tighten into a body groove. This seat should be accessible and serviceable without removing the valve from the pipeline. The seat area shall have a flow opening with no stem guides, bearings or supporting ribs.

B. ACTUATOR

The actuator assembly shall be a double chamber design with a separating partition between the lower surface of the diaphragm and the main valve. The entire actuator assembly consisting of the seal disk, valve shaft, bearing, diaphragm assembly, separating partition and top cover must be removable from the valve as a single unit. The control chamber between the diaphragm and the separating partition shall be capable of being open to or isolated from the valve internal body pressure. The stainless steel valve shaft shall be guided throughout its travel by a bearing in the separating partition. The replaceable resilient seal shall be rectangular in cross section and contained on three and one-half sides. A lip shall be provided on the seal disc outside edge to lock the seal in place. The actuator assembly must be capable of accepting a V-port throttling plug by simply bolting the device to the seal disk.

C. CONTROL SYSTEM

The control pilot shall be direct acting, adjustable, spring-loaded diaphragm actuated valve with a built-in needle valve to adjust the main valve closing speed. The body and cover shall be of brass or bronze construction with stainless steel trim and resilient seal. Liquid to the pilot must be filtered and cock valves must be provided to isolate the control loop.

D. QUALITY ASSURANCE

The main valve, pilot, control tubing, filter and isolation valves shall be factory assembled and tested. The valve manufacturer must be completely certified to the ISO 9002 Quality Assurance Standard.

E. MANUFACTURER

The valve shall be Model 720 with drill pattern 150, as manufactured by Bermad, or equal, as approved by the engineer.

VI. CASING PIPE

Bituminous coated and/or galvanized steel casing pipe shall be installed under U.S. Highways, State Highways and Railroad Crossings by the bore and jack method, where required by the U.S., State, Railroad or County, or directed by the MSUD. The Contractor shall comply with all regulations and requirements of the respective authority when encroaching on U.S Highways, State Highways, County Roads, or railroad rights-of-way. Any cost required by railroad flagmen and/or inspectors, and additional insurance required by the railroad, shall be paid by the Contractor. Reference the MSUD Detail for Profile Boring and Jacking for the placement of steel casing pipe with restrained joint, ductile iron carrier pipe within the right-of-way or crossing U.S. Highways, State Highways or railroads.

Stainless steel band, casing spacers shall be installed to stabilize the carrier pipe inside the casing pipe, and end closures at both ends of the casing pipe. Spacers shall be manufactured by Advanced Products & Systems, Pipeline Seal & Insulator, Inc., or equal as

approved by the MSUD or their Engineer. Link seals shall be manufactured by PSI / Thunderline / Link-Seal of Houston, Texas, or equal, as approved by the MSUD or their Engineer. Contractor shall provide a minimum three (3) spacers per length of carrier pipe; also one placed within 1' of each end of the casing pipe.

VII. TAPPING SLEEVE AND VALVE ASSEMBLY

All tapping sleeves and valves must be the product of Smith and Blair or Mueller. The sleeves must be held together by bolts, and valves are to be bolted to sleeves. Rubber gaskets must be furnished for use with the bolted sleeves and between the flanges of the tapping sleeve and the tapping valve. The valves on the connection or outlet sides are to have mechanical joints suitable for cast iron or ductile iron pipe. Reference the MSUD Detail.

The valves must be of standard make, double gate, cast iron body, bronze mounted with oversized seats to permit entry of the tapping machine cutters, have bevel gearing, set horizontal lie to the right or left when standing on sleeve and looking down on valve, as specified on order, open to the right (clockwise), have a 2" square nut on top of stem. Valves shall be furnished with grease case and equipped with drain plug. Grease cases shall be simple and rugged in construction and shall be designed to provide reasonable access to the valve stem, packing gland. Valves shall be designed to lie horizontal and shall be equipped with solid bronze tracks securely fastened in body and bonnets carrying the weight of the gates throughout their entire length of travel on rollers. The disc shall be carried on solid bronze rollers securely attached to the gates, also bronze scrapers shall be provided to traverse the tracks ahead of the rollers in both directions, removing any foreign matter which may have accumulated on the tracks. The valves must be suitable for safely opening or closing when subjected to full working water pressure on one side of gates and zero pressure on the other side or such a condition as occurs when the pipe on either side of the valve breaks.

All tapping sleeves and valves must be tested at not less than 150 pounds per square inch hydrostatic pressure and be suitable and guaranteed to safely stand the project's working water pressure. As minimum requirements, these valves must conform in every respect to AWWA Standard C-500 for valves.

The Contractor shall submit specifications and blueprints of manufacturer showing detail dimensions and giving the kind of metal used, tensile strength and elastic limit of metal, weight of valves and also the weight of sleeves and the diameter of stems at bottom of threads.

The Contractor shall furnish the Engineer with certificates of inspection, sworn to by the factory inspector, in the presence of a Notary Public, stating that the tapping sleeves and valves were made and satisfactorily tested in full compliance with the specifications.

VIII. TRENCHING

A. TRENCH EXCAVATION

1. For open cut excavation, the trench sides shall be approximately vertical

between an elevation of 1 foot above the top of the pipe and the centerline of the pipe; otherwise, trench sides shall be as vertical as possible.

2. The Contractor shall excavate the pipe trench by hand where excavation by machinery would endanger trees, existing utilities, or structures which otherwise might be saved by the use of hand excavation.
3. Unless otherwise directed, all trenches in which pipe is to be laid shall be excavated in open cut, to such depths and widths as will give sufficient space for placing the pipe for drainage, and proper blocking and backfilling under the pipe. The width of the trench at the top of the pipe shall not exceed four-thirds ($4/3$) of the internal diameter of the pipe plus eight (8) inches. A greater trench width may be permitted where it is necessary to sheet or brace the trench. There shall be a minimum of four (4) inches clear space on each side of the pipe to permit placing of backfill around the pipe.
4. The trenches will be opened to the depths so that the top of the pipe when laid shall not, in general, be less than thirty-six (36) inches below the grade of the street surface or ground. In the case of a pipe crossing a stream, ditch, or under obstruction, the grade of the pipe shall be so adjusted that fittings will not be required in the line. Before laying the pipe, the trench shall be opened far enough ahead to reveal obstructions. The pipe shall be straight and uniform and shall be kept at a uniform distance from the centerline of the street or roadway.
5. Where rock is encountered in the trench, it shall be removed to a depth 6" below the pipe and backfill of suitable material placed in trench before laying pipe.
6. Bell holes shall be dug to permit the entire straight barrel of the pipe to rest on the prepared bedding. Boulders or loose rocks, which might bear against the pipe, will not be permitted in the trench bottom or backfill.
7. Excavated material consisting of muck, mud, or other unstable material shall not be stockpiled for backfill. Contractor shall remove such material from the site as it is excavated and shall dispose of it in areas provided by him.

B. EXCAVATION BELOW NORMAL GRADE

1. In the event the Contractor through error or carelessness excavates below the elevations required, the Contractor shall at his own expense backfill with suitable granular backfill as hereinafter specified and compact to obtain a suitable pipe bedding or structure support as defined in the specifications.
2. In the event unstable or unsuitable bedding material is encountered at or below the limits of excavation noted on the drawings, such material shall be removed and replaced with suitable compacted granular backfill material as hereinafter specified.

C. SHEETING, SHORING AND BRACING

The Contractor shall provide and install such sheeting and shoring as may be required to support the sides of any excavation to prevent earth movement that could endanger the work or workmen, or any existing structures, or to confine the construction within a specified area such as an easement or street right-of-way. It shall be the Contractor's responsibility to place this sheeting and shoring for such protective purposes without instructions. Pipeline sheeting shall extend below the pipe invert.

D. HANDLING WATER

1. The Contractor shall at all times during construction provide ample means and devices with which to remove promptly and dispose of promptly all water entering the trench and structure excavations and shall keep said excavations acceptably dry, until the structures to be built therein are completed. All water pumped or drained from the work shall be disposed of in a suitable manner without damage to utilities, pavement, pipes, electrical conduits, or any other work or property.
2. Drainage shall be adequate. No pipe shall be laid in water and no water shall be allowed to rise above the bottom of any pipe while it is being jointed, except as otherwise permitted in writing. No masonry shall be placed in water and no water shall be allowed to rise over masonry until the concrete or mortar has attained its initial set, nor shall water be allowed to run over completed masonry for four days. In no event shall water be allowed to rise so as to set up unequal pressures in the structures until the concrete or mortar has set at least 24 hours and also until any danger of flotation has been removed.
3. Dewatering, if required, shall be continued during construction to keep the groundwater below the level of the backfill at all times until the backfill is completed.

IX. OBSTRUCTIONS

It shall be the responsibility of the Contractor to contact all utility companies in advance of any excavation in order to locate all underground utilities. If any underground utility is encountered, it shall not be disturbed until the respective Utility Company is advised and the Contractor is directed by the Utility Company to proceed. Any utility displaced or disturbed shall be promptly replaced in good condition by the Contractor.

Excavation material shall be disposed of so as to interfere as little as possible with public travel. At all street crossings and road crossings, only one-half of such street crossings and road crossings shall be excavated before placing temporary bridges over the site excavated, for the convenience of the traveling public. All temporary bridges, barricades, lanterns, and watchmen by night and such other signals and signs by day, as shall be necessary to warn

the public of the dangers caused by excavations and other obstructions, shall be provided by and at the expense of the Contractor.

X. BLOCKING

All bends, tees, crosses, plugs, pressure connections, etc. shall be backed up and anchored with concrete so that there will be no movement of pipe due to internal or external pressures. Efforts shall be made in placing this blocking so as not to cover the bells of fittings and weep holes of hydrants. In cases when concrete blocking will not be adequate because of unstable material, the fitting shall be restrained by other means such as restraining glands or threaded rods approved by the District. See two MSUD Details for Concrete Blocking, for blocking dimensions. Reference MSUD Detail for Reverse Concrete Blocking, when required, as part of water main installations.

XI. LAYING PIPE

A. GENERAL

Proper and suitable tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used. Great care shall be taken to prevent damage to any interior coating on pipes and fittings. All pieces shall be carefully examined for defects, and no piece shall be installed, which is known to be defective. If any defective piece should be discovered after having been installed, it shall be removed and replaced with a sound one, as approved by the MSUD, in a satisfactory manner by the Contractor, at his own expense. Pipe and fittings shall be thoroughly cleaned before they are installed, and shall be kept clean until they are accepted in the completed work.

Whenever trenching is required in roadway pavements, the amount of pavement removed will depend on the width of trench required for the installation of the pipe, valves or structures to be installed. The width dimensions of the trench shall not exceed by more than 6 inches on either side of the width of the excavation required to install the pipe or special fitting or structure. Methods such as sawing or power spading shall be employed to ensure the removal of pavement along straight lines.

The Contractor shall protect all piping, equipment and materials from damage at all times during construction and until the final acceptance by the MSUD of the completed work. Pipe openings shall be closed with plugs or caps during installation. Equipment shall be properly covered and protected against dirt, water, chemicals, or mechanical injury at all times. Prior to final acceptance of the work, all piping and equipment shall be thoroughly cleaned and delivered to the MSUD in perfect condition.

Unless otherwise indicated, minimum depth of cover over all buried piping shall be 36 inches for pipe, as measured from the ground level to the top of the pipe.

Blasting for excavation shall be permitted only after securing approvals and establishing the hours of blasting as required by the MSUD. The blasting

procedures, including protection of persons and property, shall be in strict accordance with federal, state and local regulations.

Trees, shrubs, fences, and all other property and surface structures shall be protected during construction. The contractor shall replace all damaged property to their original condition.

B. LAYING AND INSTALLATION

The laying of water pipe shall, insofar as it applies, conform to AWWA Specification C-600, latest revision. The pipe must be laid in a straight line and a grade without kinks or sags and shall be laid in a workmanlike manner. Before each piece of pipe is lowered into the trench, it shall be thoroughly swabbed out to insure that it is clean. Each piece of pipe shall be lowered separately. Care shall be taken to prevent injury to the pipe coating, especially on the inside of the pipe and on the inside of the specials. No piece of pipe nor special casting which is known to be defective shall be laid or placed in any line. If any defective pipe or special casting shall be discovered after it is laid in the line, it shall be removed and replaced with a satisfactory section of pipe or special without additional charge. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe. Water mains shall be laid at least 10 feet horizontally from sewer line; the distance shall be measured edge-to-edge. When conditions prevent a horizontal separation of 10 feet, a water main may be laid closer to a sewer provided that the bottom of the water main is at least 18" above the top of the sewer.

C. CONNECTION TO EXISTING WATER MAINS

The old existing mains may be of non-standard dimensions. It shall be the responsibility of the Contractor to determine the type of couplings and fittings necessary to connect the new mains with the existing mains. The Contractor shall closely coordinate the connection of new water mains to existing water mains with the MSUD. Reference the MSUD Detail for Reverse Tie-in, when required, as part of the water main installation.

D. BEDDING

For ductile iron pipe outside traffic areas and ordinary conditions, the pipe shall be bedded in accordance with the Type A section of the MSUD Detail for Trench Details. In traffic areas, the bedding and backfill shall be in accordance with the Type B section of the MSUD Detail for Trench Details. Reference the MSUD Detail for Trench Pavement Repair (ST-270) for new water mains installed under paved roads, shoulders or sidewalks owned and maintained by the Metropolitan Nashville and Davidson County, Department of Public Works. Reference MSUD Detail for Concrete Encasement, when the installation of new water mains require concrete encasement.

No separate payment shall be allowed for gravel backfill inside roadways, parking lots, driveways, and other traffic areas. The cost of that gravel backfill shall be merged into the Contract's unit pipe price bid.

E. BACKFILL

Where trenches are cut across or along pavements, graveled roadway shoulders, sidewalks, driveways, parking areas or other areas subject to pedestrian or vehicular traffic, the areas disturbed by construction shall be temporarily paved by placing and spreading crushed stone and/or temporary pavement (cold mix) thereon. Such temporary pavement shall be maintained by the Contractor until the required permanent pavement, driveway or property restoration has been completed.

The backfill of trenches outside of roadways from a point 8 inches above the top of the pipe upward shall be clean earth material. Individual stones shall not exceed 6 inches in maximum dimension.

The trench excavation shall have the top one (1) foot backfilled with fine loose earth free from large clods, vegetable matter, debris, stones, or other objectionable materials; and the adjacent surface of the work shall be left in a neat and workmanlike condition. Backfill around valve boxes and other structures shall be conducted in the same manner as specified herein before.

Any settlement of backfill below the original ground surface shall be remedied by the Contractor for a period of one year after final completion and acceptance by the MSUD.

All surplus excavated material which is not used in backfilling shall be removed from the job site and disposed of by the Contractor at his own expense in a manner satisfactory to the MSUD. The Contractor shall not use any vacant lot or private property as a spoil site without the written authorization of the owner or his agent.

F. SHUTTING DOWN WATER MAINS

Where it is necessary to shut off water mains to make connections or for capping, the work shall be done as quickly as possible so as to cause the least inconvenience possible to the water consumers, but not exceeding four (4) hours.

All shut-downs shall be scheduled by the Contractor and must be approved in advance by the MSUD. If it is deemed necessary by the MSUD, critical shutdowns shall be scheduled for night and/or weekends.

The Contractor shall not operate any valves on existing water mains and/or water mains placed in service under this Contract without prior approval and only under the supervision of the MSUD representative.

The Contractor shall provide all water customers at least 24 hours notice of an intended shutdown, or interruption of water service.

G. MAINTAINING WATER SERVICE

The water service to consumers, whose connections are to existing mains in the street where the proposed mains under the Contract are to be constructed, must be maintained by the Contractor so that they will not be deprived of water service while said proposed mains are being constructed. The Contractor shall closely coordinate with the MSUD, all situations requiring a short-term interruption of water service that cannot be avoided.

H. ABANDONING EXISTING WATER MAINS

It shall be the responsibility of the Contractor to remove from the ground all existing valve boxes over valves on abandoned mains. All valves on the abandoned main shall be closed only when directed by the MSUD representative.

On valves to be abandoned, the frame and cover shall be removed and safely stored to prevent loss or damage until picked up by the MSUD. The hole shall be filled with gravel and the surface restored. Reference the MSUD Detail for Existing Valves to be Abandoned.

XII. OPEN ENDS

Open ends of unfinished pipelines shall be securely plugged and closed when the work is left temporarily at night or at other times.

XIII. DEFLECTION OF PIPE

On curves, the maximum deflection of the pipe shall not exceed the recommendations of the manufacturer of the pipe. Where required, fittings shall be used in order to obtain the proper radius of curve. Reference the MSUD Detail for Maximum Full Length Pipe Deflection.

XIV. HYDROSTATIC TEST

Hydrostatic test shall be in accordance with AWWA Specification C600.

Pressure during test: After the pipe has been laid and partially backfilled, all newly laid pipe, or any valved section of it, will be subjected to a pressure of at least 150 psi at the lowest point along the test section or 1.5 times the operating pressure at the highest point along the test section, whichever is greater.

Duration of Pressure Test: The duration of each pressure test shall be at least two (2) hours.

Procedure: Each valved section of pipe shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, and all necessary apparatus, including gauges and meters, shall be furnished by the contractor.

The Contractor shall furnish all necessary labor, equipment, including taps for the making of the test.

Expelling Air Before Test: Before applying the specified test, all air shall be expelled from the pipe. To accomplish this, taps shall be made, at points of highest elevation, and afterward tightly plugged. **Examination Under Pressure:** All exposed pipes, fittings, valves, hydrants and joints shall be carefully examined during the open trench test. Any cracked or defective pipes, fittings, valves, or hydrants discovered in consequence of this pressure test shall be removed and replaced by the Contractor with sound material in the manner provided in these specifications, and the test shall be repeated until satisfactory to the MSUD.

Permissible Leaks: Suitable means shall be provided by the Contractor for determining the quantity of water lost by leakage at the specified test pressure. No pipe installation will be accepted until or unless this leakage is less than that calculated by formula in Section 5.2 AWWA C-600, 'Standard for Installation of Ductile Iron Water Mains and their Appurtenances'. In calculating leakage, the MSUD will make allowance for added joints in the pipe line above those incidental to normal unit lengths of pipe.

Variation from Permissible Leakage: Should any test of combined sections of pipe laid disclose leakage per mile of pipe greater than that specified or if individual sections show leakage greater than the specified limit, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.

Leakage Defined: Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any section of it closed by valves, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

XV. FLUSHING WATER MAINS

All lines shall be thoroughly flushed to remove accumulated debris. This flushing is to be accomplished before the installation of the blow-off and before chlorination. A final flushing will be required after disinfection.

XVI. DISINFECTING WATER MAINS

Before being placed in service, the entire line shall be chlorinated. Chlorine may be applied by the continuous feed method in accordance with AWWA C-651, Section 4.4. Water from the existing distribution system or other approved source of supply shall be made to flow at a constant, measured rate into the newly laid water main. At a point not more than 10 feet downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 25 mg/l free chlorine. To assure that this concentration is provided, measure the chlorine concentration at regular intervals in accordance with the procedures described in the current edition of Standard Methods or AWWA M12, 'Simplified Procedures for Water Examination,' or using appropriate chlorine test kits.

The amount of chlorine required for each 100 feet of pipe of various diameters shall be as follows:

Pipe Diameter (Inch)	100 percent Chlorine (lb)	One percent Chlorine Solutions (gal)
4	0.013	0.16
6	0.030	0.36
8	0.054	0.65
10	0.085	1.02
12	0.120	1.44
16	0.217	2.60
20	0.339	4.06
24	0.488	5.85

Solutions of one percent chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires one pound of calcium hypochlorite in 8 gallons of water.

During the application of chlorine, valves shall be positioned so that the strong chlorine solution in the main being treated will not flow into water mains in active service. Chlorine application shall not cease until the entire main is filled with heavily chlorinated water. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24-hour period, the treated water in all portions of the main shall have a residual of no less than 10 mg/l free chlorine.

Hypochlorite solution shall be applied to the water main with a chemical feed pump designed for feeding chlorine solutions. Feed lines shall be of such material and strength as to withstand safely the corrosion caused by the concentrated chlorine solutions and the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the solution is applied to the main. A bacteriological test is necessary before a water line or any section thereof be placed in service. Samples shall be taken by a qualified representative of the laboratory and sent to the Department of Public Health for testing. If the results of the test are positive, the line shall again be sterilized as previously stated, and samples shall again be submitted to the Department of Public Health for testing. No line or line segment shall be placed in service until negative results are obtained.

XVII. CONCRETE

Concrete for miscellaneous concrete and concrete blocking shall have minimum 28 days strength of 3500 psi, and shall conform to the requirements of ACI.

All concrete shall be adequately protected from injurious action of the sun by keeping it wet, covering with water-saturated covering, or other methods satisfactory to the MSUD or their Engineer.

Concrete shall be mixed and placed only when the temperature is at forty degrees (40) F. or above and rising, unless specifically authorized by the MSUD or their Engineer, in which event all materials shall be heated in a manner approved by the MSUD or their Engineer. In freezing weather, suitable means shall be provided for maintaining the concrete at a temperature of a least fifty degrees (50)F. for a period not less than seventy-two (72) hours after placing, or until the concrete has hardened. Salt, chemicals, or other foreign materials shall not be mixed with the concrete for the purpose of preventing freezing.

All concrete shall be placed in the dry, upon clean, damp surfaces, free from water, and never upon soft mud or dry or frozen earth.

Freshly placed concrete shall be protected from wash by rain, flowing water, mud deposits and other injurious conditions.

XVIII. PERMITS AND EASEMENTS

The Owner or Developer will obtain permission to excavate in the streets and alleys in order to install these water lines as shown on their plans. The Owner or Developer will also obtain where necessary, easements covering right of egress and ingress and installation of water lines where the same are located on private property. The Owner or Developer will, if necessary, obtain permission from the Department of Highways or Railroad Company, where water lines are to be constructed along or across highways or railroads.

Where easements are obtained through areas of woods and/or vegetation, the Owner, Developer or Contractor, will be responsible for providing the necessary clearing and grubbing to allow the MSUD access to the water main. The MSUD may require that the Owner, Developer or Contractor install an access drive within the easement, per the MSUD Detail for Gravel Drive.

XIX. TOPSOILING AND SEEDING

A. GENERAL

The Contractor shall furnish all material, labor, equipment and supervision required to finish grade and seed as shown on the Drawings and as specified hereinafter. All areas of construction shall be seeded including trenching for pipes. The Contractor will be responsible for a satisfactory growth of grass as specified, free of weeds and foreign growth. It is the Contractor's responsibility to see that the planted areas receive sufficient water until accepted by the MSUD.

B. FINISH GRADING

As soon as practical after completion of backfilling at all structures, the Contractor shall rough grade all areas on the site which are not to be paved. The entire area to be seeded shall be spread with a six-inch layer of suitable topsoil, carefully spread, disked lightly into the existing soil and finished to the grade indicated on the drawings; followed with one pass of a flat roller weighing not more than 100 pounds per linear foot and not less than 25 pounds per linear foot. No power rolling will be

permitted within 8 feet of any wall or structure. On slopes steeper than 4:1, the topsoil shall be rammed or tamped into place.

C. FERTILIZING

Fertilizer shall be uniformly distributed at a rate approximately 7.5 pounds per 1000 square feet over the disturbed areas. The fertilizer shall be applied, if possible, seven (7) to ten (10) days prior to seeding. Fertilizer shall be a complete fertilizer, the elements of which are derived from organic sources. Fertilizer shall be a standard product complying with State and Federal fertilizer laws.

Percentages of nitrogen, phosphorus and potash shall be 15% nitrogen, 10% phosphorus and 10% potash by weight. At least 50% of the total nitrogen shall contain no less than 3% water-insoluble nitrogen.

Fertilizer shall be delivered to the site, mixed as specified, in the original un-opened standard size bags showing weight, analysis and name of manufacturers. Containers shall bear the manufacturer's certificate of compliance covering analysis shall be furnished to the MSUD or their Engineer. Store fertilizer in a weatherproof place and in such a manner that it will be kept dry and its effectiveness will not be impaired.

D. SEEDING

Seed shall be uniformly distributed at a rate of not less than eight (8) pounds per 1,000 square feet. Seed shall be lightly covered by raking or approved mechanical equipment and the soil compacted by rolling. Seed shall be a mixture of Kentucky 31 Fescue and perennial rye seed, minimum pure seed content of 85 percent with a minimum germination of 80 percent. The seed shall meet the requirements of the State Department of Agriculture and Consumer Service.

E. MULCHING

Mulch shall be normally dry mulch and shall consists of wheat, rye or barley straw. Seeded areas shall be mulched by applying straw over the area to a minimum depth of 2 inches (loose), mulching shall be done within 48 hours of the time seeding is completed.

The mulching equipment shall be Rotovator, or other equipment determined by the MSUD or their Engineer to be equally suitable for cutting the specified material uniformly into the soil and the required controlled depth.

F. MAINTENANCE

The Contractor shall maintain the grass until final acceptance. Maintenance shall consist of preserving, protecting, resodding or reseeding and such work as may be necessary to keep the work in a satisfactory condition. The Contractor shall be responsible for satisfactory growth of grass and, until acceptance, shall water and

mow the grass at such intervals as will insure living and growing grass at the time of acceptance. A satisfactory growth of grass shall be interpreted to mean the establishment and growth of 90 percent of the grass planted 30 days after planting.

G. FINAL CLEANUP

All areas of construction shall be restored to original or better condition. Areas shall be clean and free of debris.

XX. ROAD, DRIVEWAY, PARKING AREA AND SIDEWALK REPLACEMENT

All bituminous and concrete roads, driveways, parking areas, sidewalks and ramps shall be replaced to the section and of the same material, including base course, as that removed or disturbed. All edges broken from bituminous or concrete roads, driveways, parking areas, sidewalks and ramps shall be sawed or cut off at right angles to the pavement; and, replaced in accordance with the Owner's established standards for similar work. Materials and methods of operation required for replacement shall be in accordance with the applicable requirements of the Metropolitan Nashville and Davidson County, Department of Public Works, the Tennessee Department of Highways, and U.S. Department of Highways. Reference the MSUD Detail for Street Repair for Placing Pipe Within the Right-of-Way or Crossing State or U.S. Highways, when applicable to the installation of new water mains. Reference also, the MSUD Details for Residential Concrete Driveway Ramp (ST-313) and Commercial Concrete Driveway Ramp (ST-314), when applicable to the installation of new water mains.

Any settlement of roads, driveways, parking areas, sidewalks and ramps replaced below the original ground surface, shall be remedied by the Contractor for a period of one year after final completion and acceptance, upon receipt of written notice by the MSUD.

XXI. DUST CONTROL

All available precautions shall be taken to control dust. When the MSUD judges dust to be a problem, the Contractor shall control the dust by sprinkling, by applying calcium chloride, or by other methods as directed.

XXII. WATER METERS AND BACKFLOW PREVENTION

All water meters will be supplied by the MSUD, and the Contractor shall be held responsible for the installation and cost thereof. Unless directed otherwise by the MSUD, all taps for the water meters shall be made by the MSUD. Reference MSUD Details for Meter Installations, for the size of meter appropriate to the proposed development.

All backflow prevention devices, required by the proposed development, shall be purchased and installed by the Contractor. Backflow prevention devices are subject to an annual inspection by the MSUD, to insure accurate operation. The Owner is responsible for all costs of maintenance to insure that accurate operation. Reference the MSUD Details for backflow

prevention devices and associated boxes, for the size appropriate to the proposed development.

XXIII. CROSS CONNECTION POLICY

Contractor will request copy of current "Cross Connection Policy" from the MSUD prior to start of work.

XXIV. GUARANTEE

The Contractor shall guarantee all workmanship and materials for a period of twelve (12) months after final acceptance of the work and shall, in the event of failure of any item due to workmanship or materials, replace the same without cost to the MSUD.

XXV. SUBMITTALS

If requested by the MSUD, the Contractor shall submit, for approval by the Engineer, details, Shop drawings, descriptive literature and product data for all manufactured or fabricated items, for examination, review and approval. Each submittal shall be furnished in four (4) copies, along with the proposed development plans. The Engineer's review is intended only to assure conformance with these MSUD Specifications, and shall not be construed, in any way, as releasing the Contractor from the responsibility of complying with these Specifications.