FACILITIES & OPERATIONS
ARCHITECTURE, ENGINEERING AND CONSTRUCTION
UNIVERSITY OF MICHIGAN

BuildingName
The Description of the Project
P00000000 0000

SPECIFICATION DIVISION 33
NUMBER SECTION DESCRIPTION

DIVISION 33 UTILITIES
SECTION 331100 - WATER DISTRIBUTION PIPING

END OF CONTENTS TABLE

Delete this cover sheet in the specifications set.

Add section 22113 to the overall title sheet.

Material specifications within the City of Ann Arbor must meet or exceed City of Ann Arbor current material standards. Note that their Orange book and web link may be outdated.
http://www.a2gov.org/departments/engineering/Pages/Engineering-and-Contractor-Resources.aspx Work through U-M AEC regarding materials.

U-M standard is minimum cl 52 DI water main.

DIVISION 33 UTILITIES

SECTION 331100 - WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for [**water main**] [**domestic water service leads**] [**fire service leads**].Edit for project specific.

1.3 DEFINITIONS

Retain abbreviations that remain after this Section has been edited.

A. AASHTO: American Association of State and Highway Transportation Officials.

B. ACI: American Concrete Institute.

C. ANSI: American National Standards Institute.

D. ASTM: American Society for Testing and Materials.

E. AWWA: American Water Works Association.

F. HDPE: High Density Polyethylene.

G. MDEQ: Michigan Department of Environmental Quality.

H. MDOT: Michigan Department of Transportation.

I. NSF: National Sanitation Foundation.

J. OSHA: Occupational Safety and Health Administration.

K. PPM: Parts Per Million.

L. PSI: Pounds per Square Inch.

M. SDR: Standard Dimension Ratio.

N. UL: Underwriters Laboratory.

O. UM: University of Michigan.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Detail precast concrete manhole assemblies and indicate dimensions, method of field assembly, and components.

C. Manufacturer Certification: All pipe and material furnished shall be accompanied by the manufacturer’s certification.

D. Cut sheets for Contractor layout and staking locations.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.6 QUALITY ASSURANCE

Retain and edit first paragraph and subparagraphs below if not applicable.

A. Regulatory Requirements:

1. Comply with requirements of the City of Ann Arbor, MDEQ, and U-M.

2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.

3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

C. NSF Compliance:

Delete first subparagraph below if NSF 14 is not applicable.

1. Comply with NSF 14 for plastic potable-water-service piping.

2. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground

or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Protect flanges, fittings, and specialties from moisture and dirt.

F. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

G. Product Inspection: All materials furnished shall be subject to inspection on arrival at the job site by the Owner or Owner's agent. The purpose of the inspection shall be to cull and reject products that, independent of physical tests specified under the standard specifications designated herein, fail to conform to the requirements of these specifications. Materials shall be subject to rejection on account of any of the following:

1. Variation in any dimension exceeding the permissible variations given in the material specifications. Pipe in all cases shall be full diameter.
2. Fractures or cracks passing through the barrel or socket.
3. Chips or fractures on the interior of the pipe exceeding two inches in length, one inch in width, or depth more than ¼ of the thickness of the wall.
4. Blisters that are either broken, exceed three inches in diameter, or project more than 1/8 inch above the surrounding surface of the pipe.
5. Variation of more than 1/16 inch per lineal foot in alignment of pipe intended to be straight.

H. Rejected materials shall be clearly marked by the Inspector and immediately removed from the site of work by the Contractor, without cost to the Owner.

1.8 PROJECT CONDITIONS

Retain this Article if interruption of existing water-distribution service is required.

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Owner no fewer than five working days in advance of proposed interruption of service. Coordination of a building system water shutdown requires a minimum of ten working days.

2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.9 COORDINATION

Edit this Article to suit Project if new water-distribution piping will connect to other on-site water-distribution piping.

A. Coordinate inspection with City of Ann Arbor or with authority having jurisdiction and with Owner's representative.

B. Coordinate water main testing and connection to existing water main with the City of Ann Arbor or authority having jurisdiction.

C. Coordinate service shutdowns with Owner's representative for impacted facilities.

D. Contractor shall **not** turn valves – coordinate with City of Ann Arbor or the authority having jurisdiction, and with University of Michigan Utilities.

E. Coordinate water service installation with the City of Ann Arbor or authority having jurisdiction.

1. For two-inch copper service or smaller, City of Ann Arbor Field Operations shall tap the water main and supply and install the proposed water service from the main to the curb box. Contractor shall supply and install the water service from the curb box to the building.

PART 2 - PRODUCTS

Note that the City of Ann Abor current approved manufacturers and products are to be referenced. The City's standard specification book may be outdated. Work with AEC to specify manufactures and products.

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint Piping:

1. Pipe: AWWA C151, thickness class 52.
   a. All pipe shall have standard thickness cement mortar lining and asphaltic seal coat in accordance with ANSI/AWWA C104/A21.4 and coated outside with asphaltic coating in accordance with ANSI/AWWA C151/A21.51.
   b. The following information shall be clearly marked on each length of pipe:
      1) Pipe designation and class.
      2) Name and trademark of the manufacturer.
      3) Country of origin. American steel only.
      4) Year the pipe was produced.

2. Mechanical Fittings: AWWA C111, for joint restraint system and bolts.
    a. Mega lug joint restraint system by EBAA Iron Sales, Inc.
    b. Bolts shall be high strength, low alloy steel bolts only.
    c. The following information shall be clearly marked on each fitting:
        1) Pressure rating of the fitting.
        2) Nominal diameters of the opening.
        3) Name and trademark of the manufacturer.
        4) Country of origin. American steel only.
        5) Number of degrees or fraction of the circle on all bends.
        6) Ductile iron fittings shall have the letters “DI” cast on them.
3. Gaskets: AWWA C111, rubber, of shape matching pipe and fittings.
    a. Lubricants used shall be supplied, or recommended, by the pipe manufacturer and the joints shall be coupled in accordance with manufacturer’s requirements.
4. Polyethylene wrap per ANSI/AWWA C105/A21.5

B. Push-on-Joint Piping:

1. Pipe: AWWA C151, thickness class 52. Pipe beneath railroads shall be thickness class 56.
    a. All pipe shall have standard thickness cement mortar lining and asphaltic seal coat in accordance with ANSI/AWWA C104/A21.4 and coated outside with asphaltic coating in accordance with ANSI/AWWA C151/A21.51.
    b. The following information shall be clearly marked on each length of pipe:
        1) Pipe designation and class.
        2) Name and trademark of the manufacturer.
        3) Country of Origin. American steel only
        4) Year the pipe was produced.
2. Standard Fittings: AWWA C110, ductile iron.
    a. All pipe fittings shall have standard thickness cementer mortar lining and asphaltic seal coat in accordance with ANSI/AWWA C104/A21.4 and coated outside with asphaltic coating in accordance with ANSI/AWWA C151/A21.51.
    b. Push-on Joints to be used unless otherwise noted.
    c. Restrained Joints
        1) TR-Flex restrained joint by U.S. Pipe.
        2) Lok-Ring joint by American Ductile Iron Pipe.
        3) Or Engineer approved equal.
    d. The following information shall be clearly marked on each fitting:
        1) Pressure rating of the fitting.
        2) Nominal diameters of the openings.
        3) Name and trademark of the manufacturer.
        4) Country of origin. American steel only.
        5) Number of degrees or fraction of the circle on all bends.
        6) Ductile iron fittings shall have the letters “DI” cast on them.
3. Gaskets: AWWA C111, rubber, of shape matching pipe and fittings.
    a. Restrained Joints
        1) Fast-Grip by American Pipe.

2) Field-Lok by U.S. Pipe.
3) Or Engineer approved equal.

b. Lubricants used shall be supplied, or recommended, by the pipe manufacturer and the joints shall be coupled in accordance with manufacturer's requirements.

4. Polyethylene wrap per ANSI/AWWA C105/A21.5

C. Domestic Water Service:

1. Pipe: ASTM B88, Type K Copper.
   a. For 2 inch and smaller water services. Larger water services shall utilize ductile iron pipe covered above.
2. Fittings: ANSI B16.22, wrought copper.
   a. Minimize joints. Joints shall be flare connection or brazed.
   b. All fittings shall be lead free.

2.2 HDPE PIPE AND FITTINGS

A. HDPE Pipe, AASHTO/ASTM M294/F892, AWWA C906 meeting ANSI/NSF Standard 14, SDR 7.0 corrugated with integrally formed smooth interior.

1. N-12 pipe by Advanced Drainage Systems, Inc. (ADS).
2. Titeline by Hancor.
3. Or Engineer approved equal.
4. AWWA C906 and NSF 14 identifications shall appear on exterior wall print line.

B. HDPE Joints, ASTM D3212, ANSI/NSF Standard 14, watertight joints using watertight sleeves.

1. Sleeves shall have an indentation in the center to ensure proper positioning of the pipe.
2. Sleeves shall be factory installed on one end of the pipe with a factory installed gasket on the other end.
3. Joints for pipe between 21" and 24" may also use silt tight joints using split coupling bands and geotextile fabric.

C. Gaskets, ASTM F477, solid cross section rubber manufacturer to fit the pipe and fittings.

D. Lubricant used in making up joints shall be supplied, or recommended, by the pipe manufacturer and the joints shall be coupled in accordance with manufacturer's requirements.

2.3 CORROSION-PROTECTION/PIPING ENCASEMENT

A. Polyethylene wrap for Underground Metal Piping:

1. Standards: ANSI C105 and AWWA A21.5.

2. Color: Black

Note to Designer:
Include Steel Casing Pipe specification, as necessary.

B. Steel Casing Pipe
1. Standards: ASTM A 53, Type E or S, Grade B.

2. Material: Steel casing pipe shall meet the following schedule of thickness based on nominal diameter of casing pipe:

Nominal Diameter of Casing Pipe (inches)	Minimum Wall Thickness (inches)
Under 14	0.250
14, 16, and 18	0.312
20 and 22	0.375
24, 26, 28, and 30	0.500
32 and 34	0.563
36, 38, 40, 42, and 48	0.625

3. Identification: The following information shall be clearly marked on each length of pipe.
   a. The pipe designation and class.
   b. The name or trademark of the manufacturer.
   c. Identification of the manufacturing plant.

2.4 VALVES

A. Gate Valves, certified by UL or NSF for use in a potable water system and shall meet current City of Ann Arbor Material Standards, or authority having jurisdiction:

1. Resilient seat non-rising stem push-on.
2. Two-inch square operating nut.
3. Right-hand open.
4. Joints meeting ANSI/AWWA C111/A21.11.
5. Gate valve shall be of the following models, unless otherwise noted in the City of Ann Arbor Division III Material Standards:
   a. Series 300 and T300 NRS Double Disc Gate Valve by Waterous.
   b. A-2380 Series by Mueller.
   c. Series A by East Jordan Iron Works.
   d. AWWA 571X by Kennedy.
   e. Or Engineer approved equal.
6. 16 inch and larger gate valves shall be furnished with 3 inch valved by-pass, right-hand open.
7. 20 inch and larger gate valves shall be furnished with bronze rollers, tracks and scrapers, having enclosed beveling gearing, and shall be installed horizontally. Gearing shall consist of cut tooth cast steel gears with rolled bronze pinion shafts having a minimum mechanical advantage ratio of 2 to 1.
   a. List 14 AWWA Gate valve by Eddy – Iowa Division or James B. Clow & Sons, Inc.

B. Butterfly Valves, AWWA C504-74, certified by UL or NSF for use in a potable water system and shall meet the current City of Ann Arbor material standards, or authority having jurisdiction:

1. Two-inch square operating nut.
2. Right-hand open.
3. Butterfly valve shall be of the following models, unless otherwise noted in the City of Ann Arbor Division III Material Standards:
   a. Groundhog by Henry Pratt.
   b. Lineseal III by Mueller.
   c. Or Engineer approved equal.

C. Tapping Sleeve and Valves, rated for a minimum 250 psi working pressure, certified by UL or NSF for use in a potable water system and shall meet the current City of Ann Arbor material standards, or authority having jurisdiction.

1. Sleeve shall meet current City of Ann Arbor Material Standards or authority having jurisdiction:
   a. F-5205 by Clow.
   b. H-615 by Mueller.
   c. Series 800 by Waterous
   d. Or Engineer approved equal
2. Tapping Valve and shall meet the current City of Ann Arbor material standards, or authority having jurisdiction.
   a. Double-disk type, of the same manufacturer as the sleeve.
   b. NRS with 2-inch square operating nut.
   c. Right-hand open.
   d. Mechanical joint outlet.

D. Gate Valve Box shall meet the current City of Ann Arbor material standards, or authority having jurisdiction:

1. Buffalo type, Size D, screw type, 3-piece, 5-1/4-inch shaft.
   a. #6 base for valves 8 inches or less.
   b. #8 base for valves 10 or 12 inches.
   c. Valve standards for valves 16 inches or larger shall be coordinated with the City of Ann Arbor.
2. Casting cover shall be labelled “Water” in raised lettering.
3. Tyler 6860 or Engineer approved equal.

E. Curb Boxes shall meet the current City of Ann Arbor material standards, or authority having jurisdiction:

1. Buffalo type, Size 95E, screw type, 2-piece, 2-1/2-inch shaft, extendable from 4-1/2 feet to 6 feet.
2. Curb boxes shall meet the current City of Ann Arbor Division III Material Standards and shall be the following unless otherwise noted by the City of Ann Arbor:
   a. H-10350 by Mueller.
   b. 6500 by Tyler
   c. B-2000 by Bibby Ste. Croix
   d. Or Engineer approved equal.

Edit to meet current City of Ann Arbor products or authority having jurisdiction. U-M water main material for pipes greater than 2” shall be CL 52 DI.

2.5 FIRE HYDRANTS

A. Fire Hydrant, ANSI/AWWA C111/A21.11:
1. 6-inch mechanical joint pipe connection.
2. Two 2-1/2-inch National Standard hose connections.
3. One 3-1/2 inch Ann Arbor Standard pumper connection.
   a. 7-1/2 threads per inch.
   b. 4.05 inch outside diameter.
4. 3/8-inch pentagon operating and cap nuts.
   a. 1-3/8-inch point-to-flat at top.
   b. 1-7/16-inch point-to-flat at base.

5. Left-hand open.
6. Breakable flange construction.
7. No barrel drain.
8. Color: Red.
9. Depth of bury: 6 feet.
10. Fire hydrant shall meet the current City of Ann Arbor material standards, or authority having jurisdiction:
    a. Model 5-BR 250 by East Jordan Iron Works.

2.6 MANHOLES

Retain this Article if vaults are required and are not specified in Section 033000 "Cast-in-Place Concrete" or Section 033053 "Miscellaneous Cast-in-Place Concrete."

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
4. Base Section: 8-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, of length to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type as indicated; with top of cone of size that matches grade rings.
7. Joint Gaskets: ASTM C 443, rubber O-ring gasket. Joints pointed with mortar after installation, both inside and outside of the manhole.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection. Neoprene rubber shall meet ASTM C 443 and have a minimum thickness of 3/8 inch. Pipe clamps shall be of corrosion-resistant steel. Pipe connectors shall be one of the following:
    a. Flexible neoprene rubber boot securely clamped into a core-drilled pipe port. Pipe ports shall be core-drilled at the point of manhole manufacture and shall be accurately located within ½ inch of proposed sewer centerline.
    b. Self-adjusting mechanical pipe to manhole seal providing resilient flexible and infiltration-proof joint.
    c. Flexible rubber wedge firmly secured against a rubber gasket cast into the manhole.
    d. Engineer approved equal.
9. Steps: ASTM C 478 injection molded copolymer, polypropylene, encapsulating a ½ inch grade 60 steel reinforcing bar with an impact resistance of 300 ft-lbs and a pull out force resistance of 1500 lbs; Cast or anchor steps into sidewalls at 15-inch intervals. Step depth shall a minimum of 6 inches.
10. Grade Rings: 2-inch Reinforced-concrete rings, 2-inch minimum and 6-inch maximum height, with diameter matching manhole frame and cover.

11. Aggregate Base: Structure shall be placed on a minimum of 4 inches of 21AA limestone bedding.
12. Manholes shall be used for housing gate valves, only as called for on the plans.

B. Manhole Frames and Covers:

1. Description: East Jordan Iron Works, 1040 with type “C” lid or Engineer approved equal. Include indented top design with lettering cast into cover, using wording equivalent to "WATER".
2. Material: ASTM A 48, Class No. 30, gray iron unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of water main. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Excavate trench according to OSHA guidelines and backfill the trench as indicated in the City of Ann Arbor utility trench details or as directed by the Engineer.

Note to Designer:
Water main connection shall be coordinated with the water supplier having jurisdiction. In some cases, this may not be City of Ann Arbor.

C. Water-Main Connection: Coordinate with City of Ann Arbor or authority having jurisdiction and Owner’s representative for connections to existing water main.
1. Owner shall be notified 5 working days prior to any proposed interruption of service. Coordination of a building system shutdown requires a minimum of 10 working days’ notice.
2. Dry Tap:
   a. Contractor shall coordinate with the Owner for water main gate valve shutdowns. Contractor shall not turn valves.
   b. Contractor shall provide means for maintaining the site of the tap in the dry in the event that existing water main valves provide a poor shutdown.
   c. All pipe, fittings, and appurtenances necessary to complete the water main connection shall be on site prior to excavation for the connection.
   d. No water main shutdown will take place after 12:00pm, unless expressly granted by the Owner.

3. Wet Tap:
   a. Prior to the installation of a tapping sleeve, the section of pipe to be tapped shall be cleaned of all foreign material and wire brushed to a smooth surface.
   b. The tapping sleeve shall be installed per manufacturer's guidelines.
   c. All pipe materials and appurtenances shall be disinfected with a strong chlorine solution prior to installation.
   d. Tap assembly shall be tested using the test plug tap in the sleeve with the valve closed, or by placing a tapped plug on the outlet of the valve with the valve open. The assembly shall be pressurized to 150 psi and hold the pressure for fifteen minutes.
4. Water Service Tap:
   a. 2″ copper water service lead or smaller will be performed by the City of Ann Arbor's Field Operations Unit who will supply and install copper from the water main to the curb box. The Owner will be responsible for the copper lead from the curb box to the building.
   b. Greater than 2″ water service and for ductile iron water service, Contractor shall tap the main and supply and install the proposed water service from the main to the building. Coordinate inspection with City of Ann Arbor or with authority having jurisdiction.

Retain paragraph a.) above if tap is made by utility company; retain Paragraph b.) above if tap is made by Contractor.

D. Setting Joints: Mechanical means shall be used for pulling home all rubber-gasketed pipe regardless of trench condition where manual means will not result in pushing and holding the pipe home.
   1. When trench box or liner is used, the Contractor shall provide and use a cable to pull the joints home and hold them in position.
   2. When work is performed in wet trenches or trenches with running sand, the Contractor shall ensure that the interior of the pipe remains clean and dry.

Retain first paragraph and subparagraphs below for tapping of pipe with connections NPS 2 (DN 50) and smaller.

E. Permissible Deflection at Joints, the deflections shall not exceed the following amounts:

Size of Pipe	Joint Angle	Deflection in 18 feet	Approx. Radius of Curve
(Inches)	(Degrees)	(Inches)	(Feet)
4	5	19	205
6	5	19	205

8	5	19	205
10	5	19	205
12	5	19	205
16	3	11	340
20	3	11	340
24	3	11	340

F. Cutting Water Main Pipe:

1. Flame or torch cutting of water main pipe is not allowed.
2. Pipe shall be cut in a manner that will not damage the pipe or cement lining of the pipe and shall provide a clean and 90 degree cut.

G. Abandoning Water Main:
1. Cut the end of the main in accordance with the section above.
2. Work with U-M Project Manager for City approved method of pipe abandonment and appurtenance removal.
3. Break down existing water structures, remove manhole casting and cover, grade rings, and top 4 feet of structure. Backfill remainder of the structure with MDOT class II sand.

H. Anchorage for Water Main Fittings and Appurtenances:
1. All plugs, caps, tees, hydrants, and bends shall be provided with a Class A concrete reaction backing (thrust block). Thrust block shall be placed between unexcavated solid ground and the fitting to be anchored.
   a. Thrust block shall be placed such that the pipe and fittings are accessible for repairs, which shall include protection of any bolts from direct contact with the concrete.
   b. Metal harnesses of tie rods or clamps may not be used instead of thrust block.
   c. Friction clamps or set-screw type retainer glands will not be allowed for thrust restraint.
   d. Restrained joint gaskets rated for 350 psi are required for vertical bends.

3.3 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Install FRP manholes according to manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

Retain paragraph below only if specified in "Manholes" Article.

E. Install manhole-cover inserts in frame and immediately below cover.

3.4 WATER MAIN TESTING

A. Contractor shall coordinate all work around water main testing. Any additional time required to obtain a passing result in any of the water test will not be considered sufficient cause for an extension of time.

B. The water main shall be disinfected and tested by the Contractor in the presence of the Public Services Director in accordance with the requirements below. The Contractor shall furnish all piping, pumps, gauges and other materials and equipment required to carry out the tests using water from the City's water mains. Any hoses which are needed to direct water from blow-offs and/or hydrants during water main testing and flushing shall be supplied by the Contractor. The City shall furnish and install one-inch corporation stops at all necessary locations, at the expense of the Contractor. The tapping of water mains, the installation of all corporations stops, and the operation of valves and hydrants is reserved for City personnel. The Contractor is required to assist in valve and hydrant operation, however. The Contractor shall give the City 48 hour's prior notice of intent and desire to test water mains. If the Contractor so desires, the Public Services Department – Engineering Division will (when personnel and equipment are available) perform disinfecting and pressure testing for the Contractor at the Contractor's expense.

C. Connections to the existing water main shall not be made until the new water main has been successfully pressure tested and has passed bacteriological testing. Final connections shall be coordinated with the Engineer. The Contractor shall coordinate all water system shutdowns with Owner's Representative and the City of Ann Arbor.

D. Construction Sequence, the normal sequence and time requirements for testing are as follows:

Isolated (Gapped) Water Main	Connected Water Main
1. Fill Main	1. Flush and Swab*
2. Pressure Test	2. Chlorinate
3. Connect One End of Main	3. Wait 24 hours
4. Flush and Swab*	4. Flush**
5. Chlorinate	5. Wait 24 hours

6. Wait 24 hours	6. Bacteriological
7. Flush**	7. Wait 24 hours
8. Wait 24 hours	8. Bacteriological
9. Bacteriological samples	9. Wait 48 hours
10. Wait 24 hours	10.Pressure Test, ifsamples pass
11. Bacteriological samples	11. Flush*
12. Wait 48 hours	12. Wait 24 hours
13. Make Final Connections	13. Bacteriological
	14. Wait 24 hours
	15. Bacteriological
	16. Wait 48 hours
	17. Make Final Connections

* Collect flush water in operable storm water retention/detention facility.

** Discharge flush water into approved sanitary sewer.

E. Hydrostatic (Pressure Test):
1. Maximum length for testing is 1,500 feet.
2. Slowly fill main and pump pressure to 150 psi. Test pressure shall be maintained between 145-155 psi.
3. Testing Period – 3 hours.
4. Water shall be chlorinated to 25 ppm.
5. If leakage exceeds maximum allowable leakage, as specified below, the joints shall be carefully inspected and any that are found to be leaking shall be removed and replaced at no cost to the Owner.
6. The following chart shows the maximum allowable leakage:

Maximum Allowable Leakage per 100 Joints at 150 psi Avg. Test Pressure

Pipe Diameter (inches)	4	6	8	10	12	16	20
Leakage (gallons/hr)	0.66	0.99	1.32	1.66	1.99	2.65	3.31

F. Flushing and Swabbing:

1. The following swabs are approved for use:
   a. Girard Aqua Swab (AS) 2 lbs/cf density swab polly-pig.
   b. Or Engineer approved equal.
2. Water main shall be flushed such that the polly-pig is pushed from end to end of the proposed water main.

G. Chlorination, disinfected in accordance with AWWA C65I “Disinfecting Water Mains” and as specified herein:

1. Water shall be chlorinated to a minimum residual 50 ppm with commercial liquid chlorine solution (sodium hypochlorite).
2. Duration shall be 24 hours with a remaining free available chlorine residual of at least 25 ppm. If less than 25 ppm residual is shown at the end of the 24 hour period, additional chlorine shall be added until a minimum 25 ppm residual is maintained for 24 hours.
3. After passing result, the chlorinated water shall be removed from the water main and disposed of into an existing, owner approved, sanitary sewer main.
4. The minimum recommended dosage of sodium hypochlorite is as follows (based on 10% available chlorine)

Recommended Minimum Chlorine Dosage to Disinfect 100 L.F. of Pipe

Pipe Diameter (inches)	10% Chlorine Solution (gallons)
6	0.153
8	0.272
10	0.426
12	0.613
16	1.090
20	1.703
24	2.452

H. Bacteriological Testing:

1. City of Ann Arbor will take samples to verify chlorine content meets specifications and for bacteriological testing.
2. 24 hours must elapse between flushing of the main and the first sample taken.
3. 48 hours are required to obtain test results for each sample.

3.5 IDENTIFICATION

Note to designer: Verify with U-M Civil and/or Design Manager if tracer wire will be necessary. HDPE water main requires tracer wire.

A. Install continuous underground tracer wire during backfilling of trench for underground water main.

Delete paragraph above if metallic water-service piping without electrically insulated fittings will be used.

END OF SECTION 221113