

SECTION 232100 - UNDERGROUND CHILLED WATER SYSTEM

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

- A. Chilled Water Distribution Systems: The University of Rochester Campus is served by a central plant chilled water system. Steam-powered centrifugal and electric chillers provide chilled water for most of the central campus buildings as well as the University of Rochester Medical Center. Variable-speed pumps deliver water to a loop distribution system from which the separate buildings are served.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage:

- 1. Contractor shall be responsible for inspecting materials delivered to site for damage.
- 2. Materials shall be stored in enclosures or under protective coverings. Materials shall not be stored directly on ground.
- 3. Plastic piping and rubber gaskets shall be stored under cover, out of direct sunlight.
- 4. All piping materials shall have ends plugged during storage on site and while installing in the trench until just prior to connection to adjacent pipe sections. Piping that has dirt and debris on the inside will be rejected by the inspecting engineer.

B. Handling:

- 1. Pipe, fittings, valves, and other accessories shall be handled in such a manner as to ensure delivery to the job site in sound, undamaged condition.
- 2. Special care shall be taken to avoid injury to coatings and linings on pipe and fittings. The Contractor shall repair damaged coatings and linings to the satisfaction of the Owner.

PART 2 PRODUCTS

2.1 CHILLED WATER PIPING, VALVES AND APPURTENANCES 3 INCH AND LARGER DIAMETER

- A. Polyvinyl Chloride Pipe (PVC): Pipe shall conform to AWWA C900 / AWWA C905 DR 18, cast-iron O.D. sizes, working pressure to 235 psi. Pipe shall be of domestic manufacture: JM Mfg. Co., PW Eagle Pipe, or Certainteed Fluid Tite, North American Pipe; no substitutions. Pipe shall be furnished with integral bells. Spigot end pipe with separate double hub couplings is not acceptable.

Where in close proximity to steam lines and for pipe entering through foundation or manhole walls the underground piping for chilled water system distribution shall be a minimum Ductile Iron Pipe (DIP): Pipe shall conform to AWWA C151, minimum pressure class 250. All ductile iron pipes shall be cement mortar lined in conformance with AWWA C104 and shall have a 1 mil thick exterior petroleum asphaltic coating. Pipe shall be of domestic manufacture: U.S. Pipe, American Ductile Iron Pipe (American Pipe), or Atlantic States. No substitutions.

2.2 WATER LINES 2-INCHES AND SMALLER DIAMETER

- A. Pipe shall be annealed (soft) Type "K" copper (Cu). No hard copper tubing is permitted.

2.3 POLYETHYLENE ENCASEMENT

- A. Buried ductile iron pipe and fittings shall be encased in polyethylene in accordance with AWWA C105.

2.4 COUPLINGS AND SLEEVES

- A. General: All couplings and sleeves for plain end pipe, and accessories shall be of domestic manufacture; U.S. Pipe, Tyler/Union Foundry, Smith-Blair; no substitutions.
- B. Solid sleeves shall be mechanical joint type conforming to AWWA C153 as manufactured by Tyler/Union Foundry, US Pipe, or American Ductile Iron Pipe. No substitutions.
- C. Couplings: Quantum Couplings as manufactured by Smith-Blair, Inc or Dresser Style 38, by Dresser Piping Specialties. No substitutions.
- D. Unless otherwise noted, flanges on all DIP spools shall conform to AWWA C115.

2.6 COPPER TUBING

Couplings and pipe thread adaptors for copper tubing shall be Mueller 110 Compression Connection or Ford Meter Box Company, Inc., Compression Couplings or equal.. Soldered joints are not permitted.

2.7 ASSEMBLY BOLTS AND NUTS

Bolts and nuts for above ground flanges shall be standard hex head, cadmium plated machine bolts with American Standard Heavy, hot pressed, cadmium plated hexagonal nuts. Buried flange nuts and bolts shall be as above except they shall be of Type 304 stainless steel. Bolts and nuts for mechanical joints shall be high-strength, low-alloy corrosion resistant steel conforming to ASTM A 325 (type 3).

2.8 FITTINGS

- A. Fittings for pipe sizes 4-inches thru 12-inches shall be mechanical joint, AWWA C153, 350 psi working pressure rated, ductile iron for use with the type of pipe specified. Fittings shall be cement mortar lined per AWWA C104 and shall have a 1 mil thick exterior petroleum asphaltic coating. T-bolts shall be AWWA C111, high strength, low alloy steel. Fittings and all accessories shall be of domestic manufacture; U.S. Pipe TrimType, Union Foundry, Tyler; no substitutions.
- B. Fittings for pipe sizes 14-inches thru 36-inches shall be mechanical joint, AWWA C153, 350 psi working pressure rated, ductile iron for use with the type of pipe specified. Fittings shall be cement mortar lined per AWWA C104 and shall have a 1 mil thick exterior petroleum asphaltic coating. T-bolts shall be AWWA C111, high strength, low alloy steel. Fittings and all accessories shall be of domestic manufacture and shall be supplied by same manufacture as the pipe manufacture.
- C. Fittings used at intersections of water mains where valves are required shall be mortar lined, flanged fittings. Valves at these locations shall have flange by mechanical joint ends. Flange bolts and nuts at these locations shall be stainless steel.
- D. Fittings for copper pipe 2-inches in diameter and smaller shall be soldered wrought copper.

2.9 MECHANICAL JOINT RESTRAINTS

- A. Mechanical joint restraints for Ductile Iron pipe and PVC pipe sizes 4-inches thru 24-inches shall be Mega-Lug® type as manufactured by EBAA, Inc. Series 1100 or Uni Flange Retainer (UFR 1400 D) for Ductile Iron pipe and EBAA, Inc. Series 2000PV or Ford meter Box UFR 1500 for PVC pipe. No Substitutions.
- B. PVC piping shall be restrained at the two pipe joints before and after bends or at every joint if called out in the design documents. The restraint method shall incorporate the use of a restraint harness. A split serrated ring shall be used to grip the plain-end of the pipe. A split serrated ring shall also be used to grip the barrel of the pipe behind the bell, and a sufficient number of bolts shall be used to connect the restraint rings. The combination shall be the MegaLug Series 1900 as manufactured by EBAA Iron Works or Smith Blair Bell-Lock Joints, no substitutions.
- C. DIP piping shall incorporate the use of restrained joint pipe systems at every joint. The allowed restraint mechanisms are as follows:
 - 1. Restraint harness comprised of a split serrated ring shall be used to grip the plain-end of the pipe; a sufficient number of bolts shall connect the restraint ring to the ductile iron fitting. The restraint for mechanical joint fittings shall be the MegaLug Series 1100; the restraint for push-on fittings with restraining ears shall be the MegaLug 1700 as manufactured by EBAA; or Smith Blair Bell-Lock Joints no substitutions.
 - 2. Locking gaskets such as Field-Lok gaskets as manufactured by US Pipe or “Fast-Grip” brand as manufactured by American Pipe, rated to withstand pressures of up to 250 psig.

2.10 GATE VALVES

- A. Buried gate valves 4-inches thru 8-inches diameter shall be Mueller resilient wedge gate valve model A 2360 series, or Kennedy Valve AWWA C509, 250 psi working pressure, non rising stem with square operating nut (turned counterclockwise to open), and –“O” ring packing; no substitutions, 3-inches size shall be by an approved manufacturer.
- B. Above ground Gate valves 2-inches and smaller shall be Milwaukee with handwheel or approved equal, buried gate valve shall be Kennedy AWWA 509, or approved equal.

2.11 BUTTERFLY VALVES

- A. Buried Butterfly valves 8-inches thru 36-inches diameter shall be AWWA C504, Class 150B Mueller Lineal III, Pratt ‘Ground Hog’ or M &H Valve Company, no substitutions.
- B. Furnish with enclosed operators with 2-inches square operating nut. Nut turned counter-clockwise (left) to open.
- C. Isolation Valves, General:
 - 1. The pressure ratings indicate the maximum allowable value. All valves will meet or exceed the performance specifications and requirements of AWWA C500 and AWWA C504. Valves, vents and drains will be coated to protect against corrosion.
 - 2. Isolation Valves, Direct Buried:
 - a. Valves shall be suitable for bi-directional flow and drop tight shutoff to 150 psig (zero leakage). Seats shall be adjustable in-line without the need of special tools. All valves shall be hydrostatic and leak tested in accordance with AWWA.
 - b. Isolating, butterfly valve for buried service, flanged body, AWWA C504 Class 150B, ASTM A126, Class B – Cast Iron. Seat EPDM, Disc – Alum. Bronze. Gear operators for 8-inches and larger valves. All surfaces to be coated with polyamide cured epoxy according to SSPC-SP-10 to

- a minimum of 6 mils in compliance with AWWA C550. Standard of Acceptance: Mueller Lineseal III, Pratt – Groundhog; Tyco Keystone.
 - c. Provide valves with shaft extensions with centering rings to within one foot of grade.
 - d. Valve boxes shall be 2 – piece cast iron, screw type, 5¼-inches shaft with stay-put heavy-duty traffic weight lid marked “CHILLED WATER” to match piping system. Boxes shall be manufactured by Bibby-STE-Croix, Tyler Union or Bingham & Taylor. Valve boxes to be coated with coal tar for buried service application.
 - e. Provide one tee wrench for valve actuation to Owner.
3. Drain and Air Vent Valves:
- a. 1.5-inches to 4-inches: Working pressure 150 psig at 38°F, ball valve, carbon steel body, stainless steel ball and stem, welded ends, carbonized PTFE and FDM seats.

2.12 TAPPING SLEEVE AND VALVE

- A. Tapping sleeves for 4-inches thru 12-inches mains shall be cast iron, 200 psi working pressure; Mueller H 615/H 619 or approved equal.
- B. Tapping valves shall be Mueller resilient wedge gate valve model A 2360-16, or Kennedy 8950 SS, 250 psi working pressure, non rising stem with 2-inches square operating nut (turned counterclockwise to open), and "O" ring packing; no substitutions, with flanged or mechanical joint ends.
- C. Tapping sleeves and valves for mains 14-inches diameter and larger shall be Mueller H 615/H 619 or approved equal.

2.13 SERVICE SADDLES

- A. Service saddles for pipes 4-inches thru 12-inches diameter shall be Mueller BR2B Double strap bronze with AWWA I.P. thread or Ford Meter Box 202B. Tap diameter to match service connection size.
- B. Pipes 14-inches thru 36-inches diameter shall be Smith Blair model 317 with fusion nylon coated body; 2-inches IP threaded outlet, or Ford Meter Box FCD202, double stainless steel straps and stainless steel bolts and nuts.

2.14 AIR RELEASE VALVES

- A. Air release valves shall be 2-inches, cast-iron body, threaded inlets, stainless steel trim, floats, seats, and linkage. Air release valves shall be universal air-vacuum type, Val-Matic 200 series, or APCO 200A Series, no substitutions. These air release valves shall be at the high points of the piping system.
- B. Corporation stops (for use with air release valve connections): Corporation stops shall be 2-inches size, cast bronze body, plugs, and trim, and IP threaded for saddles, Mueller H-15023, or Ford Meter Box FB1000, no substitutions.

2.15 ACCESSORIES

- A. Valve Extension Handles: Extension handles for supply valves shall stop not less than 3-feet from grade. Extension handles for return valves shall stop not less than 2-feet from grade.
- B. Valve Boxes: A valve box shall be provided for each buried valve; as outlined in 2.11.C.2.d. Valve boxes shall be marked "CWS" and "CWR" welded on the rims for chilled water supply and chilled water return valves respectively. Letters shall be 1-inch high minimum.
- C. Wall Penetration Sleeves: 1/8 inch hot-dip galvanized steel sleeve with 1/8 inch continuously welded 2-inches weep ring shall be provided.

D. Wall Penetration Seals: Elastomeric link-type mechanical seal; Thunderline Link-Seal or approved equal. Refer to "Underground Chilled Water Wall Penetration Details".

2.16 TRACER WIRE

A. No. 8 AWG insulated copper wire, solid or stranded, shall be provided in sufficient length to be continuous over each separate run of pipe and looped into each valve box.

2.17 MARKING TAPE

All buried pipelines shall have plastic warning tape installed a minimum of 12-inches above the top of the pipelines. The warning tape shall be a minimum of 2-inches wide and blue with black lettering reading "CAUTION, CHILLED WATER MAIN BURIED BELOW".

2.18 PIPE BEDDING MATERIAL

A. All pipe to be placed and 6" deep bed of sand free of rocks and debris. Back fill over pipe up to 6" over top of pipe with sand. See detail on page 10, Section 4.0

PART 3 EXECUTION

3.1 INSTALLATION

A. Except as noted herein or on the plans, all water system structures, components, and appurtenances shall be constructed and installed in accordance with the applicable AWWA specifications.

B. Connections to Buildings:

1. Buried connections to buildings shall be made with ductile iron pipe and flange assemblies in accordance with detail shown on page 11, Section 4.0 'CW Typical Wall Penetration Detail'.
2. Pipe entering the building shall be anchored to the building wall or otherwise restrained against hydrostatic forces resulting from unrestrained joints in the pipe system external to the building.

3.2 MINIMUM COVER FOR UNDERGROUND LINES

A. Lines 4-inches and greater diameter: 60-inches minimum cover.

B. Lines less than 4-inches diameter: Paved areas: 60-inches minimum cover; Landscaped and unimproved areas: 60-inches minimum cover.

3.3 VALVE INSTALLATION

A. Valves, extension handles, and valve boxes shall be installed in accordance with AWWA C600, AWWA C605 and applicable Standard Drawings for valve and fitting installation.

B. Insides of valve boxes and bottoms of covers shall be painted blue for supply valves and purple for return valves.

C. Air release valves shall be installed at all high points of piping system.

D. Valve Box Installation: Valve boxes shall be installed within the asphalt or concrete surface, as the site requires. When boxes are set in pairs, the "CWS" and "CWR" markings on the rims shall be placed at points closest to each other to indicate valve pairs.

3.4 THRUST BLOCKS

- A. Central Utilities prefers using EBAA Iron, Inc Series 1100 Mega-Lug mechanical joint thrust restraints on all fittings in lieu of concrete thrust blocks. On certain piping the use of additional tie rods restraints on bell and spigot pipe joints may also be required, Mega Lug series 1700 style tie rod system.
- B. Where restrained mechanical joints are not used, concrete thrust shall be provided for all pressure pipe fittings, changes in pipe alignment/direction, and at all other points where there is a possibility of joint separation under pressure and no other method of restraint is specified. Provide anchors and supports where necessary for fastening work into place. Make proper provisions for expansion or contraction of pipelines. Thrust blocks shall be placed between solid ground and the pipe or fittings to be anchored as detailed. Thrust blocks shall be as detailed on the drawings, or where not detailed, in accordance with AWWA C600 and pipe manufacturer's recommendations. Use 4,000 psi strength concrete mix (28 days strength). See detail of page 9, Section 4.0, Typical CW Branch Connection
- C. Backfilling operations at thrust blocks may begin as soon as the concrete has set sufficiently to remain in position and withstand the weight of the earth. Concrete shall not be disturbed or pressure loaded for at least five (5) days after placing unless otherwise permitted by the Owner and a minimum of 2500 psi compressive strength is achieved.

3.5 UNDERGROUND PENETRATIONS OF BUILDING AND MANHOLE WALLS

- A. Penetrations of concrete walls shall be core-drilled holes or cast-in-place PVC or galvanized steel sleeves with seals.
- B. Penetrations of masonry walls shall be galvanized steel sleeves with seals.
- C. Seals shall be installed in accordance with manufacturer's instructions.

3.6 FLUSHING

- A. Prior to hydrostatic testing, pipe system shall be flushed with fresh water until piping is free of dirt and foreign matter. Piping shall not be flushed using water from the chilled water system. Dechlorinate prior to discharge of domestic water to storm drainage. Contractor shall provide all necessary hoses and connections between the domestic water system and the chilled water system. Contractor shall be responsible for properly disposing of flush water. Sterilization of chilled water system piping is not required.
- B. After flushing chilled water main, Contractor shall demonstrate main is free of debris with video camera inspection or other method approved by the Owner.
- C. Upon completion of the flushing process the contractor shall circulate commissioning chemicals in accordance with University of Rochester, Central Utilities, water treatment policies and procedures. The duration of the circulation shall be a minimum of a 48 hour duration. After acceptance of the pretreatment process the piping systems shall be drained, water used in the treatment process shall be captured and disposed of offsite in accordance with State and Federal regulations. Filling and venting the piping system with chilled water from a fire hydrant, and not from the chilled water loop itself, shall be coordinated with the Central Utilities Underground Distributed Utilities Manager. A ten working day notification, request to be issued in writing, shall be provided to Central Utilities prior to the commencement of the chemical treatment and filling process. The contractor shall provide a detailed plan outlining the proposed approach to accomplish this work. Central Utilities will have 5 working days to review and accept the plan. Once acceptance is issued the contractor can commence with the work.

D. Flush Sequence and Products:

- Fill system with clean domestic water pH from 7.0 to 10.
- Add Nalprep IV alkaline phosphate cleaner at 270 ppm. See chart below.
- Circulate for 48 hours
- Flush to within 1.0 ppm ortho phosphate and 1.0 ppm iron.
- Take sample to confirm.
- Refill with city water. For cooling loops add 50% glutaraldehyde to sterilize at 108 ppm.
- Circulate for 8 hours

Nalprep IV Dosing

System Volume (gal)	Gallons of Nalprep	Gallons of H-550 to Add
100	0.23	0.01
500	1.14	0.05
1,000	2.29	0.10
2,000	4.57	0.19
5,000	11.4	0.48
6,000	13.7	0.58
15,000	34.3	1.44

3.7 HYDROSTATIC PIPELINE TESTING

- A. After the pipe has been laid and backfilled it shall be subjected to hydrostatic pressure tests. Tests shall not be conducted until at least 12 hours have elapsed since pipe laying and at least five (5) days have elapsed since placing of concrete thrust blocks. The pipe shall be filled with water, which shall remain without external application of pressure for 24 hours before tests are conducted.
- B. Prior to hydrostatic testing, flush pipe system with fresh water until piping is free of dirt and foreign matter.
- C. Pressure shall be applied by a pump and measured by a test gage. The Contractor shall furnish all necessary apparatus and labor for conducting the pressure and leakage tests.
- D. The Contractor is responsible to ensure the release of air from the line during filling, as well as the prevention of collapse due to vacuum when dewatering the line.
- E. For pressure test, use a hydrostatic pressure not less than 225 psi. The duration of the test shall not be less than 4 hours. The pressure shall not vary by more than 5 psi for the duration of the test.
- F. For portions of new mains with butterfly valves, use a hydrostatic test pressure of not less than 225-psi. Protect new butterfly valves from pressures above 150 psig. The duration of the test shall not be less than 4 hours. The pressure shall not vary by more than 5-psi for the duration of the test.
- G. Leakage Defined. Leakage shall be defined as the quantity of water that must be supplied into a newly laid pipe or any valved section to maintain pressure within 5-psi of the specified test pressure after the pipe has been filled with water and the air expelled. A drop in pressure in the test section shall not measure leakage over a period of time.

- H. Allowable Leakage. No pipe installation will be accepted if the leakage is greater than that determined by the following formula per AWWA C600-93:

$$L = (S * D * \sqrt{P}) / 133,200$$

Where:

L = allowable leakage, in gallons per hour

S = length of pipe, feet

D = pipe diameter, inches

P = test pressure, psi

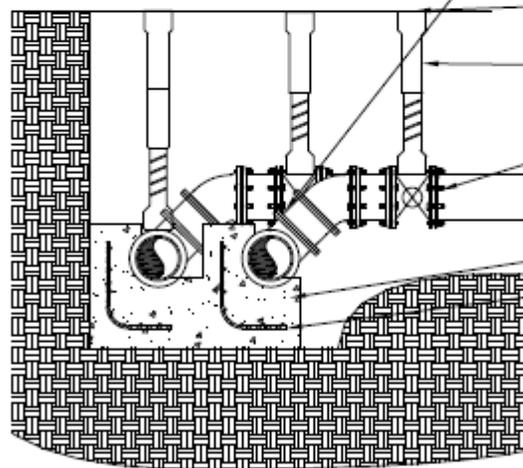
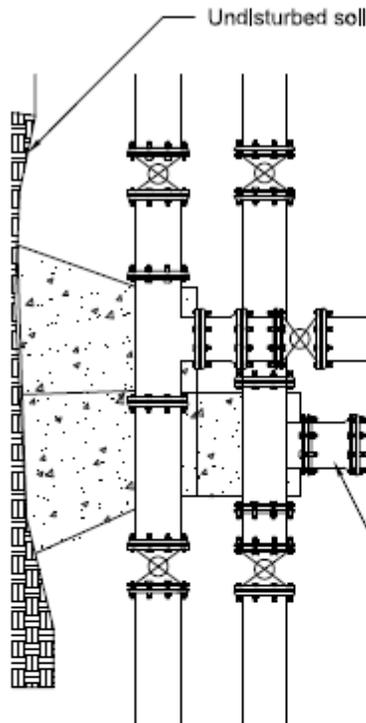
- I. Acceptance. Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than specified in Section 3.07.H, repairs or replacements shall be made by the Contractor's at his own expense.

4.0 Details

The following details are provided for use in the design and installation of the underground chilled water system.

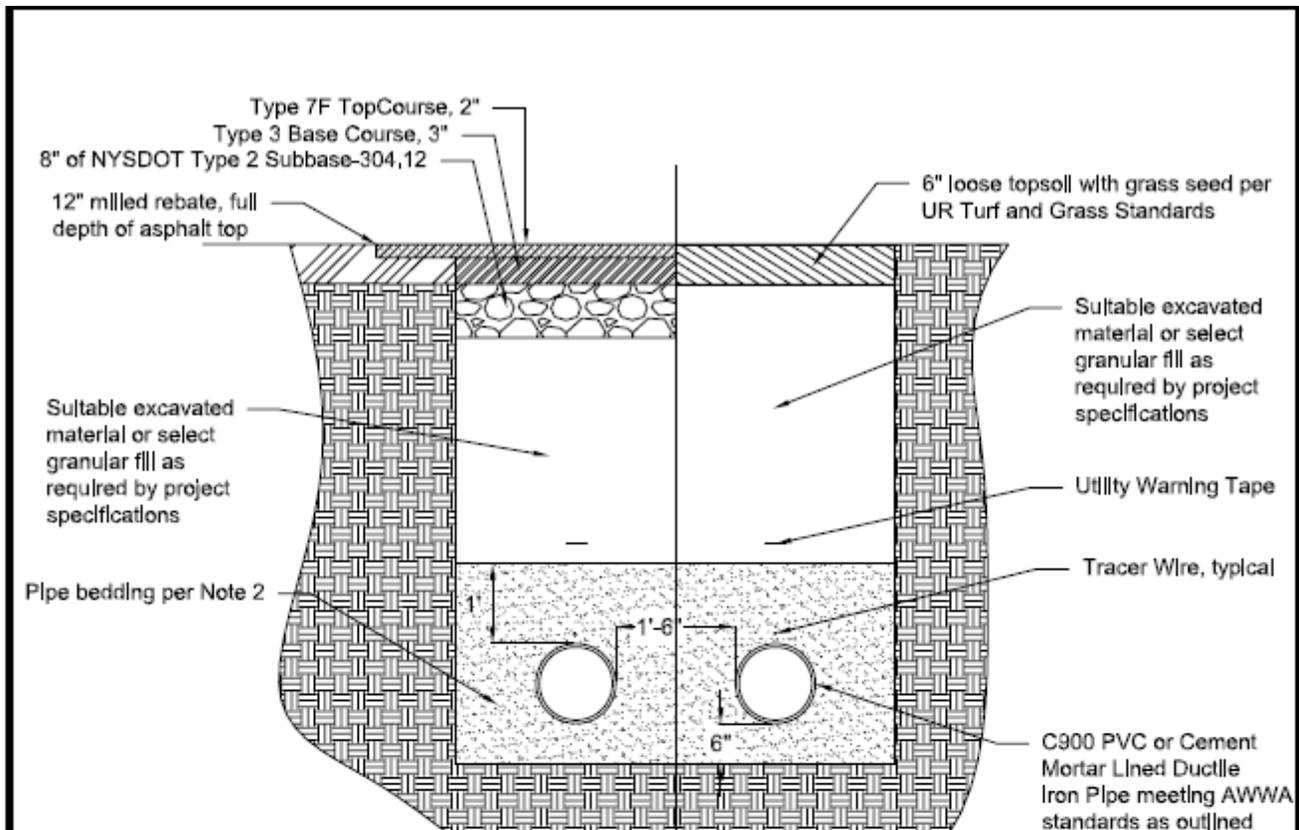
Notes:

1. Each branch connection shall have a "nested" valve arrangement comprised of a full line size valve on each side of the tee.
2. All fitting shall be AWWA compliant, Cement Mortar Lined DIP, PC150.
3. All fittings shall be restrained with MEGA-LUG Restraints, or equal, as specified in the UR Standards. The use of MEGA-LUG restraints will minimize the size requirements of the thrust blocks, however, thrust blocks shall be utilized in all situations to prevent lateral and longitudinal movement of the piping system.
4. Thrust blocks are required only at tee locations to limit movement of the fitting. Thrust block dimensions shall be determined by the project design team utilizing the depicted layout as a guide. Rebar dimensions in the detail are minimums with larger piping sections requiring more reinforcement.
5. Thrust blocks shall rest and thrust against undisturbed earth in all situations.
6. Forming systems shall accommodate the need for the concrete to form directly against the trench wall.
7. Concrete shall have a 4000 psi compression strength per ACI standards.



Typical CW Branch Connection

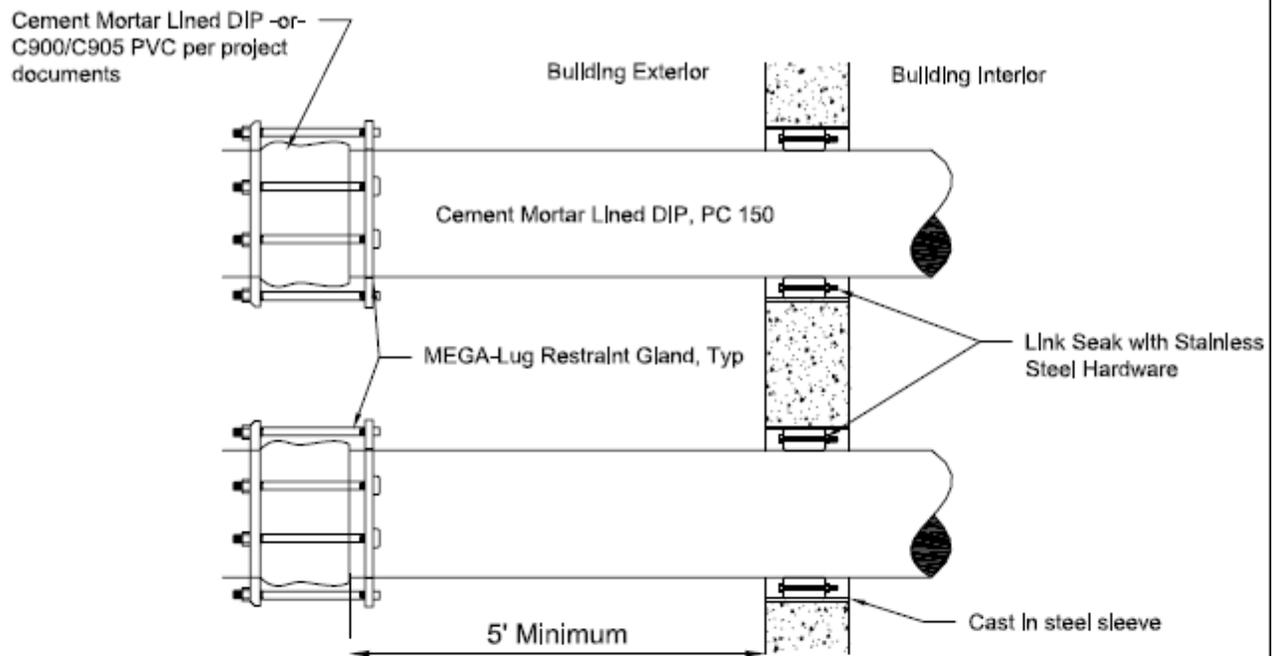
	DRAWN OR REVISION BY: Dkt. Mappin, P.E.	DRAWING NAME: Underground Cased Branch Connection	DRAWING LOCATION:
	DATE: 05/23/2013	DRAWING SCALE: 1/1" = 1'-0"	BUILDING NUMBER: UR CENTRAL UTILITIES PLANT



Notes:

1. All sub-grades shall be compacted to 95% Modified Proctor prior to placement of pipe bedding materials
2. Pipe shall be bedded in a minimum of 6" sand bedding material as per NYSDOT 703.06-Cushion Sand. Sand shall encapsulate pipe section all around. Bedding material zone shall extend 12" above top of pipe. All sand bedding shall be compacted to 95% Modified Proctor.
3. Fill material above pipe zone shall be suitable excavated materials or as defined by project specifications which ever is more stringent. All fill material above the pipe bedding zone shall be compacted to 95% Modified Proctor. Level of compaction shall be determined by laboratory testing or nuclear density testing, or other suitable means as determined by the contract documents
4. Tracer wire shall be installed above each pipe in the trench, oriented along the center line of the pipe. Tracer Wire shall be a minimum of 10 AWG insulated copper wire.
5. Utility marking tape, blue in color reading: "CHILLED WATER" in black letters, shall be installed immediately above the pipe bedding zone.
6. Restoration of grade surfaces shall meet, at a minimum, the requirements outlined in the detail above.
7. Chilled Water piping shall maintain a separation of 18" minimum.
8. Clear space between the piping and the trench wall shall be minimum of 12."

UNIVERSITY OF ROCHESTER	DRAWN OR REVISED BY: Pat Maffly, P.E.	DRAWING NAME: Underground Chilled Water Trench Detail	DRAWING LOCATION:
	DATE: 05/03/2013	DRAWING SCALE: 1"=1'	BUILDING NUMBER: UR CENTRAL UTILITIES PLANT



CW Typical Wall Penetration

Notes:

1. Piping penetrations through exterior concrete walls shall be accomplished via either of the following mechanisms:
 - 1.1. Cast in steel sleeves under new wall construction conditions
 - 1.2. Single pass core drilling of the existing concrete wall for each pipe, supply and return
 - 1.3. The Supply line shall be on the **RIGHT** side when looking at the proposed penetration from the outside of the building.
2. MEGA-LUG Restraints shall be utilized to prevent pipe separation. Bolt packs for MEGA-LUG shall be Stainless Steel.
3. Cement mortar lined Ductile Iron Pipe, PC 150, shall be installed in the sleeved/cored opening with a plain end protruding from the building wall. A minimum of 5' of DIP shall extend from the outside face of building wall.
4. Link-Seals of the proper size shall be utilized to create a water tight penetration. Thread ends of the bolt packs on the Link-Seals shall point to the inside of the building. All Link-Seals shall have stainless steel hardware.
5. Fire stopping, if required, shall be per applicable codes and standards as set forth by the jurisdictional authority.

UNIVERSITY OF ROCHESTER	DRAWN OR REVISED BY: Dan Murphy, P.E.	DRAWING NAME: Underground Cabled Water Wall Penetration Details	DRAWING LOCATION:
	DATE: 05/21/2013	DRAWING SCALE: N/A	BUILDING NUMBER: UR CENTRAL UTILITIES PLANT

End of Section